THE RUBBER AGE

ESTABLISHED 1917

COVERS ALL PHASES OF THE PRODUCTION AND MARKETING OF CRUDE RUBBER AND THE MANUFACTURE AND DISTRIBUTION OF RUBBER GOODS

Vol. 40 MARCH, 1937 No. 6

INDEX TO CONTENTS

The Rubber Age Celebrates 20th Anniversary 353
REVIEW OF THE RUBBER INDUSTRY IN THE PAST 20 YEARS

Mechanical Rubber Goods 354
By C. H. Zieme

Accelerators and Antioxidants 355
By E. B. Curtis

Latex 355
By E. A. Hauser

The Rubber Physicist 356
By S. D. Gehman

Origin of the Rubber Division, A.C.S. 357
By H. E. Simmons

Rubber Deposition 357
By R. W. Albright

The Carbon Reinforcement of Rubber 358
By W. B. Wiegand

Effect of Cure and Temperature of Flexing of the Flex Resistance of Conventional Tread Stock 363
By M. F. Torrence

Rubber Division, A.C.S., Meeting at Chapel Hill 365

Raw Rubber Coating for Pipes 367

Rubber in the Budd Sleeper Bus 368

New Equipment Section 369

REGULAR DEPARTMENTS

Late Domestic News	372	**Editorials**	371
Financial News	380	**Chemical Markets**	383
Book Reviews	370	**Statistics**	384
New England News	376	**Market Place**	388
Names in the News	379	**Advertising Index**	392
Rubber, Cotton Markets ...	382	**Classified Ads**	392

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The Rubber Age

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Vol. 40 MARCH, 1937 No. 6

THE RUBBER AGE

Celebrates 20th Anniversary

AN important milestone in the history of THE RUBBER AGE is recorded this month—the completion of 20 years of publication. Compared to the age of the rubber industry, twenty years is short, but we believe that the two decades during which THE RUBBER AGE has appeared have been the most progressive and fruitful years since the eventful discovery of vulcanization by Charles Goodyear in 1839. It has been our privilege to have recorded some of the outstanding technical developments in the history of the rubber industry—to have been a living document of the great progress which has taken place since March, 1917, when the first issue of this journal appeared.

Within our pages have appeared the stories of the many successes that inspired the industry as well as the failures which served as stepping stones to the further advancement of an industry which would not accept defeat.

It is difficult to realize that rubber manufacturing today is so far different from that of 20 years ago. Many of the materials and compounding ingredients used now were either unheard of in 1917 or were in an embryonic state. For instance, a small book issued by one of the large Akron companies in 1917, describing rubber manufacturing processes of that day, did not include any mention of carbon black in its list of the "most frequently used compounding ingredients." Nor were accelerators or antioxidants even hinted at! Accelerators and carbon black were of course in use at that time but they had not assumed, as yet, the importance they have today.

What are some of the other important technical developments of the past 20 years which have contributed to the advancement of the art of rubber manufacture? It is of interest to list just a few of them. Among the materials are: Accelerators and Antioxidants, with their many allied materials such as retarders, activators, anti-scorch and anti-sun agents; Latex in its various forms, concentrated, vulcanized, etc.; Synthetic Rubber; Softened Rubber; Rubber Powder; Dispersions of crude and reclaimed rubber. In equipment there has been constant improvement in mills and calenders and the addition of new machines and processes such as: the enclosed (Banbury) mixer; flat band method of building tires; watch case vulcanizers for tires and tubes; new laboratory testing equipment for abrasion, flex, etc.; the Geer aging oven and the Bierer-Davis oxygen bomb.

This brief summary naturally touches only the highlights—there have been scores of other developments which also helped advance the industry to its

present position. Suffice it to say that today better rubber products are made much more economically than ever before and that rubber is being used in applications not dreamed of a score of years ago.

As was said a few years back, "Rubber is so fascinating, so variable in its characteristics, so alluring in its possibilities—the field is so wide, and the industry so young—that the rubber dreamer's dream of today is a reality of tomorrow."

It is not too much to expect, therefore, that with such a record of accomplishment behind it, the rubber industry can look forward with great confidence, secure in the knowledge that the next 20 years will bring forth developments of as far-reaching importance as the past two decades.

THE RUBBER AGE is proud of the role it has played in the rubber drama during this period. It has not only recorded and mirrored the progress of the industry in its feature and news columns, but has contributed to the preservation of the literature by publishing Marchionna's "Latex and Its Industrial Applications" and Noble's "Latex in Industry."

Only last year it laid the groundwork for future contributions by bringing out the first of an annual series of bibliographies covering the literature for the preceding year. This first issue incorporated a Directory of Rubber Chemicals. The 1937 edition will be enlarged to include an alphabetical and classification Directory of Rubber Manufacturers, as well as Manufacturers of Rubber Machinery. It will, in fact, become a much needed Directory of the Industry.

It is particularly fitting at this time that the technical advances in the rubber industry since 1917 be reviewe.d Below appear several such reviews covering a few of the developments of the past 20 years and additional ones will be published in our next issue. To all these authors we are indebted for their cooperation in assisting us to present a panoramic view of the rubber industry's progress since the founding of THE RUBBER AGE.

Mechanical Rubber Goods in the Past Twenty Years

By C. H. Zieme

Service Engineer, Republic Rubber Company

MECHANICAL Rubber Goods is a general term applied to many thousands of rubber products for industrial applications. Conveyor belting, transmission belting, hose, packing, extruded, hand built items, and molded specialties represent the major groups, each of which includes many units designed to meet specific service conditions.

In the past twenty years, organic chemistry has played an important role in the extension of the number, uses and improvements in these products, thereby enabling them to meet increasing service demands. The scope of the rubber compounder has been materially broadened through the use of newly developed chemicals and ingredients which augment the physical characteristics of vulcanized rubber, such as increased toughness and flexibility, resistance to age, ability to withstand the destructive effects of light, exposure to the elements and many other desirable properties, which were not available prior to 1917. Through the correct use of organic accelerators, which promote the vulcanization or chemical union of rubber and sulphur, many changes and economies have been made in the manufacture of the products themselves.

Modern compounding practices have been instrumental in the development of many new rubber products which can be operated for a longer period under faster and more severe conditions at a lower unit cost. For example: The improvement in the toughness, heat and age resistance of covers on conveyor belt has resulted in material increase in life and usefulness; the service life of belting and other products that are subjected to repeated flexing, bending and distortion has been materially increased through the use of compounding ingredients which counteract the destructive effect of fatigue. As a result rubber belts designed for power transmission last longer and operate more efficiently.

Improvements have been made in the heat resistance of rubber as a result of research in low sulphur compounds and the life of steam hose, belting, packing and other products subjected to severe heat have thereby been materially increased. Rubber has played an important part in the rapid advancement in design and performance of the present automobile. Through the use of rubber engine supports, vibration dampeners and cushioning in body and chassis, the safety and riding comfort of the modern closed car has been made possible.

The outstanding developments in the mechanical rubber goods industry within recent years are the synthetic rubbers, neoprene and Thiokol. Products built up with these substances as a base possess physical and resilient properties similar to rubber when cured but in addition have the remarkable property of resisting the destructive action of oils and solvents. They cannot be used interchangeably as their reactions to temperature are not the same. An entirely new field of industrial application has been opened, particularly in the production and distribution of oil. Synthetic rubbers used in fuel and oil line connections of airplanes have materially advanced safety and economy in aviation and have made long flights possible. Besides being oil resistant, neoprene and Thiokol have a lower permeability to gas and are more resistant to the destructive effect of actinic rays than rubber, which has increased their application in lighter-than-air craft construction.

In addition to the extended field in compounding practices, material improvements have been made in manufacturing procedure and design of some of these products, but two examples are shown which illustrate what has been accomplished. (1) In power transmission involving heavy shock loads or high speeds, or small pulleys, endless cord belts have solved many problems. (2) The drilling of two mile deep oil wells with rotary equipment has been made possible through a combination of metal and fabric reinforced hose capable of resisting the heavy pressures in the circulating system. For this work hose with bursting pressures up to 10,000 pounds is now being used.

The horizon of research and development work in the mechanical goods industry is increasing yearly. Not alone do the manufacturers carry on an intensive program in their own laboratories and maintain a field follow-up service to check the performance of the products under actual working conditions, but chemical plants and manufacturers of compounding ingredients and accessories are equipped with modern

chemical and physical laboratories manned by trained and experienced rubber technicians who study compounding problems and industrial applications and publish the results of their findings.

From the above, it can readily be seen that there has been an extension in the number of useful products that have been supplied to industry to facilitate manufacturing operations since 1917 and that the general trend in improvement has been toward increasing the life and serviceability with a resultant lowering of manufacturing and operating costs. With the combined efforts of all of the complex factors and interests working toward a common goal, greater serviceability and many new uses for rubber products can be expected in the near future. Several of these new uses are already on the industrial horizon.

Accelerators and Antioxidants

By E. B. Curtis
R. T. Vanderbilt Company

WHEN THE RUBBER AGE came into existence in 1917, organic accelerators were making a terrific and successful attack on the inorganic accelerators—lime, magnesia and lead. Aniline was the first organic accelerator to be used in large amounts and it was soon in competition with thiocarbanilide and hexa-methylene-tetramine. The latter predominated for a time but was soon to feel competition from the guanidines. The guanidines had not long been in command when they had to begin to give way to the aldehydamines and for several years this group and the guanidines ruled the field. Late in 1926, mercaptobenzothiazole was made available to the rubber trade and three years later it had assumed leadership in the tire industry. Since then, it and its derivatives have become so widely used that today they are the dominant general purpose accelerators throughout the world.

During the past twenty years other accelerators were developed which have found an important and steadily growing application for special purposes and among these are the thiurams, the di-thiocarbamates, the zanthates and derivatives of piperidine.

The research chemists deserve great credit for their zeal, energy and cleverness in making such remarkable contributions to the art of vulcanizing rubber and credit must also be given to the compounders and production personnel for their willingness and ability to so quickly make good use of these developments in the rubber factories.

Antioxidants were not available to the rubber industry when the first issue of THE RUBBER AGE appeared. Antioxidants were made available in 1924 but they were not seized upon with the same interest and applied with the same diligence as in the case of accelerators. Over the next two or three years the use of antioxidants became large enough to indicate their importance and it became almost the general rule in the various chemical research departments to search for antioxidants as well as accelerators.

The first antioxidant to be used widely and in large amounts was a reaction product of aniline and acetaldehyde. It was followed shortly by adol-alpha-naphthylamine. These two shared the business and dominated the situation until 1930 when phenyl-beta-naphthylamine was offered to the trade. These ruled the field for two or three years, when the Ketone-amine antioxidants appeared and offered stern competition. These groups have been the major developments in antioxidants and each has, in its success, brought about an increase in the use of such chemicals. As in the case of accelerators, there have been several other important antioxidants made available that have filled special needs and the demand for them is growing.

THE RUBBER AGE was born practically at the beginning of the rubber chemicals era and at its twentieth birthday finds the rubber industry provided with a remarkably fine list of accelerators and age improvers to serve every possible requirement except one, this one need being a material that when used in reasonable quantities will offer pronounced resistance to the destructive effect of light. Continued research will eventually produce this needed material.

Latex in the Past Twenty Years

By E. A. Hauser
Massachusetts Institute of Technology

OUR first authentic information as to the direct use of rubber latex in the production of finished goods as practiced by the natives of Brazil is exactly 200 years old (Charles Marie de la Condamine and Francois Fresneau, 1737). The first systematic research on the use of latex for the impregnation of cords and fabrics, manufacture of artificial leather, etc., was carried out about one hundred years ago (Thomas Hancock, 1820-1835). The next effort to introduce latex occurs in the years between 1860 to 1865 (Charles Hancock and St. W. Silver).

With the advent of the plantation industry in the Far East, it was only natural that interest in latex acquired a new stimulus which resulted in a boom in scientific and technological latex literature and patents (V. Henri, L. Morisse, Cockerill, Ph. Schidrowitz, etc., 1905-1914). The World War once again halted the development, which so far had been hampered or completely stopped as the result of difficulties connected with the transportation and preservation of liquid latex.

In 1917, when THE RUBBER AGE made its first appearance, latex was again a curiosity, therefore, even to the greater part of the rubber chemists and technicians. Since then, THE RUBBER AGE has accurately recorded the development of our industry and in so doing has become an eternal witness of the amazing development which the direct application of latex has taken in the past twenty years. In these years the literature and patent references to latex have grown to record height. Beginning with the use of latex in the manufacture of weftless cord fabric, we find in-

creasing interest in the use of latex for spreading operations and dipped goods. The production of a stable vulcanized latex permitted the rubberizing of the finest textiles.

The organization of bulk shipments of latex and the various processes for its concentration (1923-1925) definitely established and guaranteed latex supplies in consumer countries. It is introduced in the manufacture of adhesives, liquid compounds for the sealing of cans and other containers, in the impregnation of paper, felt, and the like. It serves as the basic raw material in the manufacture of microporous hard rubber battery separators and in the manufacture of filter cloth. In combination with cements, it is used as resilient road-surfacing material.

By spraying, dipping, or electrodeposition, latex is used for coating metals and similar substances. By repeated centrifuging or creaming, it is purified to such an extent that it can be used as excellent insulating material in the manufacture of cables; it is transformed by various methods into rubber sponges of outstanding properties. In combination with natural or artificial hair, very resilient upholstery materials are being manufactured. It is also used to a considerable extent in the manufacture of rugs and plush as a binder of cheap weavings. Extrusion and twisting processes permit the production of the finest known rubber thread. Finally, the possibility of casting liquid latex compound and then solidifying it has permitted the direct application of latex in the manufacture of molded goods of complicated shape.

The past twenty years have established a new industry, based largely on the results of scientific investigation of the properties of latex. The coming years should be chiefly devoted to methods of process control and improvements in the uniformity of the raw material rather than to the working out of further application. That is what is most needed at the present time if we want to assure full success to all direct applications of latex.

The Rubber Physicist

By S. D. Gehman

The Goodyear Tire & Rubber Company

THE uses of rubber which account for the enormous expansion of the industry in the last two decades involve applications requiring a balance of mechanical and physical properties of the various compounds used. The physicist and the methods he had worked out for measuring the properties of matter were called upon early in the development of the rubber industry and became indispensable in connection with the engineering applications of this very variable and versatile material.

Once in the rubber industry, the talents of the physicist found increasing usefulness, so that, at the present time, he will generally be found occupied with (1) more or less pure research, (2) process control or development, (3) physical testing, (4) product research and development.

Typical of the pure research carried on by physicists in the rubber industry may be regarded investigations of the elastic properties of rubber. Such studies naturally take a thermodynamical aspect and are concerned with the stress-strain curve, the work done and the energy transformations during deformation. Of even more fundamental character are the numerous investigations of rubber structure by means of the methods of x-ray analysis developed originally by physicists for crystals. More recently electron diffraction patterns have been used. Besides the physical structure, the physicist is applying such methods as infra red absorption spectra and Raman spectra to help elucidate the chemical structure.

In his purer aspects, the rubber physicist has been occupied by such things as systematic investigations of the dielectric properties, thermal conductivity and gas and vapor diffusion for rubber stocks. Density and refractive index variations have been extensively studied.

The degree of control required for the smooth processing of rubber in a large factory has made many demands upon the rubber physicist. Very characteristic of this activity have been the extensive investigations of the plasticity of rubber stocks and the proper methods for its determination. Vulcanizing conditions for uniform cure have required thermocouple measurements, under the auspices of the physicist, on a large scale. In the calendering of rubber on fabric, the physicist has been concerned in the control of the uniformity of the calendered stock.

The physical testing of rubber compounds is such an important field that many physicists in the industry are occupied almost entirely in the development and improvement of such tests. For the sake of an example, we may consider the comparatively recent interest in tests on the behavior of rubber in compression, arising from its use for motor mountings. The rapid development of a new engineering use for rubber is entirely dependent on suitable tests so that the optimum properties for the stock can be determined without too many years of painful experience. The rubber physicists are making many contributions to the reliability and precision of rubber testing.

In describing the activities of the rubber physicist in connection with the products of the industry, the discussion will be very arbitrarily limited to the principal product, pneumatic tires. The fabric and pigments used in tires represent, in themselves, fields of physical research in which the rubber physicist has done notable work. The pneumatic tire is an engineering structure which is of considerable interest to a mathematical physicist.

Determination of stresses in the plies, between the plies, and in the bead, both when the tire is deflected and undeflected has occupied the attention of the physicist because of the importance of these factors in design. Such properties as the stability and load carrying capacity of tires are also subjects of inquiry. The development of the low pressure airplane tire is an example of the logical extension of the physical analysis and knowledge of the pneumatic tire and the utilization of its energy absorption possibilities.

The physicist has presided over many of the refinements which have been built into the pneumatic tire of today in the process of its adaptation to the requirements of the automotive engineer. The design of the tread for maximum non-skid properties, resistance to wear and elimination of tire noise is a problem upon which the physicist has been called in continuously. The generation of heat in tires due to the present high speeds of operation is a subject with many ramifications of interest to the physicist in the rubber industry.

Origin of the Rubber Division, A.C.S.

By H. E. Simmons

President, University of Akron, and Secretary of the Rubber Division, A.C.S., 1927-1934

THE Rubber Division of the American Chemical Society was conceived just prior to the World War, suffered its growing pains during the War, and is now a well-grown, fully developed and respected division. Dr. C. M. Knight was the first chairman of the division, and it will interest many to know that at the age of ninety years he is living at his winter home in Coral Gables, Florida. It took a man of his temperament and philosophy to keep alive the idea that some day it would be possible to have a Rubber Division.

At first it was almost impossible to arrange a program of papers for a meeting. There were two reasons for this: First, the idea of research, and its possibilities in the rubber industry had not been recognized in what at that time might be regarded as an infant industry; Second, there existed such a spirit of suspicion that the few research centers would not permit their men to read papers about what they were doing, nor even permit them to engage in public discussion of any kind for fear some one might find out what they were doing. These two conditions at one time threatened the continuance of the activities of a so-called or would-be Rubber Division.

The war brought on a great expansion in fundamental research in all fields. Large research staffs manned by men drawn from the universities began to attack the fundamental problems confronting the rubber industry. At the close of the war they had shown such progress as reflected in actual earnings of their respective companies that their staffs were enlarged from the ranks of scientific men who for patriotic reasons had gone to the aid of their country. Thus the first reason for lack of interest in the Rubber Division disappeared, and with it the second.

When all the man power, the financial, material and natural resources of the country were being brought to bear upon one common interest, namely, winning the war, it was no time for jealousy and suspicion to separate and divide our efforts.

Thus we might conclude that the war was instrumental in obtaining a co-operative research program in the rubber industry which contributed definitely to the success and growth of the Rubber Division. I feel sure the Rubber Division in its turn has justified its existence by stimulating research and by preserving the achievements of the research men.

Rubber Deposition

R. W. Albright

General Manager, American Anode, Inc.

TWENTY years ago the commercial applications of latex were practically nil. Research work had been done in laboratories, but little information of a tangible nature was available. In the early 1920's, work was done and patents issued to Drs. Paul Klein and Andrew Szegvari of the Hungarian Rubber Goods Company in Budapest and Dr. S. E. Sheppard, Mr. Leon Eberlin and Mr. C. L. Beal of Eastman Kodak in Rochester, New York, for the deposition of latex by means of ionic coagulation or the anode process.

In the one case, a zinc anode immersed in latex was connected to a source of direct current, and by electrophoretic action, the zinc ions leaving the anode caused a coagulation of the latex around the zinc form. This fundamental principle led to the logical other division of the anode process, namely, immersing in latex a form coated with a material which dissolves in water with the liberation of coagulating ions, thus causing a building up of a coagulated mass of rubber around the form as the ions from the coagulant moved away from the form and brought about agglomeration or coagulation of the latex particles they encountered.

This pioneering work led to the commercial application about ten years ago of the anode process to the rubber industry. It was essential to develop a new art of rubber compounding, deposition technique had to be learned, dispersing and grinding of materials had to be accomplished in an economical way, and much concerning the stability of latex had to be mastered before operations could be brought to a day-by-day commercial state. The control of latex mix had no background whatsoever ten years ago, but now specifications are available, and fairly positive means are used in determining the type of latex which is best used for certain manufacturing operations.

It was essential to develop a new type of manufacturing equipment for speed and ease of handling forms through the various operations. Mills and calenders gave way to tanks with proper circulation, and steam vulcanizers yielded to driers and hot air curing ovens. New materials were brought into play for forms on which to deposit latex.

From a humble introduction of surgeons' gloves, there have come a great host of articles manufactured by the anode process in a number of well-known rubber plants in this country as well as in Europe. Among the many items manufactured by the anode process are the following: gloves of all descriptions, toy balloons, rubber footwear, rubber-coated metal, rubber corsets, thread rubber, surgical sundries of many types like catheters, anesthesia equipment, blood pressure bags, etc., bladders and emergency boats, life vests, flotation gears, dress shields, baby pants, sheet rubber, etc.

It would seem that the trend is toward a greater application of the anode process to commercial use. With the ever increasing knowledge of the handling of latex, the ease of operations, as well as low capitalization and cost of equipment, the future of latex applications appears bright.

EDITORS NOTE: Space does not permit publication of all the reviews received in connection with the progress recorded in the past twenty years by various branches of the rubber industry. The next issue of THE RUBBER AGE will carry additional reviews under the following heads: The Rubber Chemist, by Harry L. Fisher; Tires and Tubes in the Past Twenty Years, by R. P. Dinsmore; Twenty Years in Rubber Footwear, by R. C. Kelley; Vulcanized Latex, by H. J. Elwell; Sponge Rubber, by R. R. Olin; Twenty Years of Crude Rubber, by E. G. Holt; Development of Rubber Powder, by R. J. Noble; Insulated Wire, by John T. Blake; Reclaimed Rubber, by L. J. Plumb; Synthetic Rubber Development, by Ira Williams; and several others covering various developments in many branches of the rubber industry in the last two decades.

The Carbon Reinforcement of Rubber*

Propounding a New Theory of Rubber Pigment Structures which Necessitates a Complete Revision of All Existing Conceptions

By W. B. Wiegand
Director of Research, Columbian Carbon Company

PART I—ITS COURSE

Evolution

DISCOVERED in England in 1910 where, however, insufficient quantities of carbon black were used, and developed commercially in Akron in 1912, the evolution of carbon reinforcement may be roughly divided into three periods: 1913-1920 during which time the art led the science, 1920-1927 during which time science led the art, and 1927-1934 when the art once more overtook the science, leading to the empirical employment of 50% or more of carbon on the rubber. At the present time there is needed a fresh theoretical approach.

The Course

The scope of carbon reinforcement may conveniently be defined as the region of positive Delta A values. The shape of the Delta A curve is in itself interesting as to symmetry, the presence of a well defined maximum, and the extraordinary extent of positive values as compared to other reinforcing pigments.

Position of Maximum

The published data on carbon Delta A functions have been assembled together with fresh data, the latter including both litharge and Captax accelerated mixings. Considerable discrepancies appear. A mean curve has been drawn to include the recent data and previous work in which fatty acids were employed. This mean Delta A curve for carbon black shows a maximum at 26.3% by volume of carbon on the rubber, corresponding to 51% by weight. This mean curve cuts the base mixing energy axis at 53.6 volumes of carbon or approximately 105% by weight.

Analysis of Delta A Curve (*See Figure 1*)

Region A, from 0 up to approximately 12.5 volumes (24% by weight), is characterized by the following properties: energy absorption rising rapidly and linearly, rebound resilience high and decreasing only slowly, electrical resistivity and breakdown voltage begin sharp decline, hysteresis low. Mixings in this region of carbon reinforcement are suitable for solid tires, electrical insulation next to the wire (for moderate voltage), shoe uppers, etc. General properties of carbon stocks in this region are toughness plus liveliness.

Region B extends from Region A to the point of maximum wear resistance taken as lying between 30 and 35 volumes. The line of demarcation is less sharply developed than that between A and B. Region B is characterized by the following properties: maximum resistance to "wear and tear", maximum energy absorption (26.3 volumes = 51% by weight), and point of inflection of rebound resilience-loading curve (27.1 volumes = 52.5%). At this point energy absorption equals 228% of base mixing.

Throughout Region B rebound resilience declines rapidly and for the most part linearly. Modulus increases throughout this Region and may with profit be looked upon as a measure of energy absorption values at the lower elongations (prior to rupture). The mechanism of "impact" abrasion as in the case of tire treads is complex but undoubtedly influenced not only by energy absorption to rupture but also by energy absorption before rupture. The fact that the latter value continues to increase, after the former has reached its optimum and is already declining, probably explains why the point of maximum wear resistance lies well to the right of the energy absorption or proof resilience optimum.

The exact position of this wear resistance optimum loading depends on conditions, speed, road surface, etc., but has been stated to lie between 30 and 35 volumes. At this point also the rebound resilience curve reverses its curvature, becoming convex to the loading axis. Also at this point the energy absorption curve begins to decline rapidly. For this reason the upper boundary of Region B has been tentatively fixed at approximately 33 volumes. Further study may require placing it still further towards the right.

Region B has at the present time the highest economical importance, being represented by tire treads, conveyor belt covers, insulated wire jackets, rubber footwear solings, etc. The exact proportion of carbon will be influenced by the nature of service, processing requirements, design of carcass, non-skid pattern, tread thickness, etc. Present practice for tire treads is to load with 50 to 55% after allowance of several per cent for flying losses.

Region C extends from Region B up to the limits of reinforcement and beyond. The upper limit under existing conditions is fixed by elongation at rupture as a factor in flex resistance of high carbon tap soles. Region C represents an unique combination of properties unapproached by any other pigment than carbon, making possible rubber articles exhibiting in combination high modulus and stiffness, good tensile, good elongation plus leather-like, plastic consistency.

Its chief application at the present time is in high

* Digest of a paper presented at the initial meeting of the Rubber Section, Toronto Chemical Association, held in Toronto, Canada, on November 20, 1936, which was published in the February, 1937, issue of *Canadian Chemistry & Metallurgy*.

carbon molded rubber solings,* and also in mechanical rubber goods specialties such as motor couplings. The compounding of carbon in Region C necessitates close attention to fatty acid content, proper mixing and refining, special precautions when reclaimed rubber is present (separate masters), special precautions in estimating proper technical cure, and selection of proper grade of carbon.

How Best to Reinforce (*With Special Reference to Region B*)

Dispersion: The problem in the case of a tire tread is to spread two pounds of rubber over ten acres of carbon. The attainment of perfect dispersion is much more difficult to recognize than in the case of the paint and lacquer industries where color, tone and gloss provide sensitive ocular criteria. Microscopic evaluation of degree of dispersion in rubber is difficult and may even be misleading because while affording some evidence of the existence of undispersed agglomerates it affords no clue as to the nature and condition of the properly dispersed material. A low-grade, coarse-particle carbon may thus show an emptier microscopic field than finer, harsher, but far better wearing, carbon.

Electrical properties provide a sensitive clue to the state of dispersion of carbon in rubber. Thus proper masterbatching has shown enormous improvements in resistivity, double values for electrical breakdown, lower dielectric constants, and lower power factors. The stress-strain curves for tire treads prepared with and without master grinds show in the case of the former higher tensile, higher modulus, lower elongation, higher tensile product, higher energy. The substitution of the proper for the improper order of mixing also produces similar changes.

In order to secure maximum benefits of carbon reinforcement mother mixings must be employed and these should be cooled and if possible passed through tightly set refining rolls. Evidence exists that such precautions cause marked increases in road mileage of tires, improvement in gloss of cut surface and flex resistance of high carbon tap soles, etc. Masterbatches should be used within a month as there is some evidence of secular changes.

Softeners should not be used in masterbatches except for a small percentage of stearic acid and pine tar (under 5% on the rubber). Experience in dispersion of exceedingly finely divided "color" blacks in the paint and lacquer industry fully confirms the importance of maintaining highest viscosity conditions.

Fatty Acid usage is in a very empirical state. Many fatty acids are unsuitable because of bloom, adverse effect on rubber properties, etc. Stearic acid is still by far the most widely used, chiefly in combination with pine tar in order to retain tack. Fatty acids play a many sided role. They are essential to acceleration; they also exert a specific effect on the carbon, probably reducing interfacial tension and strengthening the rubber-carbon bond.

The dosage of fatty acid is of cardinal importance and in the present state of knowledge should be empirically determined for each mixing depending on the type of accelerator, dosage of carbon and type of carbon. A very approximate rule is to add enough total acid material to coat the carbon with a monomolecular layer, plus an additional quantity depending on the type of accelerator and on the stearic acid content of the crude rubber used. A curve is shown giving monomolecular stearic acid requirements as a function of particle size. Rubber grade carbon requires approximately 10% by weight which, for a 50% tread, means five parts to which may be added 1% in case mercaptobenzothiazole is used; a total of 6% on the rubber in addition to that present in the crude. Of this 6% one-third may be pine tar (for tack retention) and two-thirds stearic. Crudes containing substantially less than 1.5% fatty acid require additional dosage.

Super Spectra and Royal Spectra with a particle size of 250 Å or less require much larger proportions for monomolecular coating (20-30% by weight of fatty acid on the black). Thus compounded, Super Spectra and Royal Spectra show increased reinforcement over Micronex, thus narrowing the still unexplored "zone of optimum colloidality" to approximately 250 Å. The trend of reinforcement between Micronex (500 Å) and Royal Spectra (approximately 200-250 Å) exhibits a flattening out which warrants the guess that particulate carbon finer than 200 Å will lie beyond the optimum energy absorption point and in any case will present serious processing difficulties. All particle size data below 500 Å are but crude, if shrewd, estimates.

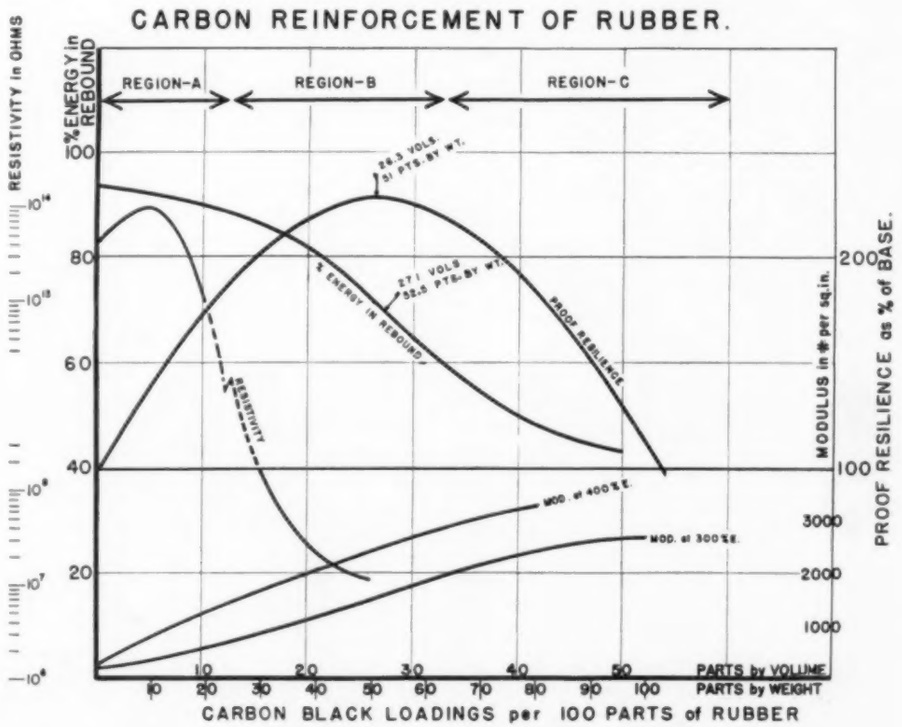


FIGURE 1—Carbon Reinforcement of Rubber

(*) See U. S. Patents 1,465,504, 1,578,875; Canadian Patents 229,369, 274,299, 248,087, 250,818.

Reduced Zinc Oxide: Take as a rough rule—There must be some zinc oxide in solution together with some not in solution. Subject to this limitation excessive zinc oxide is unnecessary. There is a tendency towards reduction to below 5% on the rubber, thus leaving room for more carbon with improved wear. Values for total zinc oxide should not be reduced below 3% on the rubber without careful investigation, at least in tire treads.

Selection of Proper Grade of Carbon: Experience in the paint and lacquer industry emphasizes the intimate relationship between proper grade and details of mixing technique. The finer the particle of rubber carbon the more attention must be paid to proper incorporation. Rough rule: For wear resistance use the finest particle black to which you are willing to do justice in your mill room.

In evaluating rubber carbons small laboratory experimental mill rolls (six inches) are not reliable because they impose more severe milling conditions than are used in the factory and thus tend to iron out dispersion differences.

Laboratory abrasion testing is still in a highly unsatisfactory condition. It does not integrate all of the contributing factors. Road testing, although itself not unequivocal and statistically showing high probable error, still remains the most reliable, if also by far the most costly, test. The possibility that the high hysteresis of carbon-reinforced treads may play a constructive role in wear resistance will receive attention in Part II.

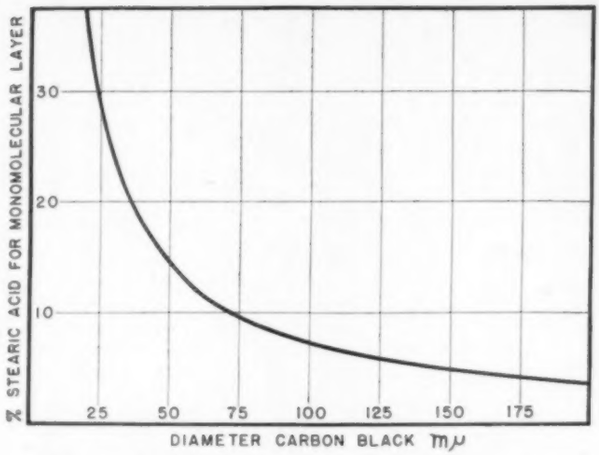


FIGURE 2—Relation Between Diameter of Carbon Black Particle and Percentage by Weight of Stearic Acid Required to Form a Monomolecular Layer.

Tread Wear Versus Tread Cracking

The tire tread compounder of today is hard pressed between the Scylla of tread wear and the Charybdis of tread cracking. Anti-oxidants and anti-flexors, improved carcass and tread design, proper dispersion of carbon which has been especially manufactured and controlled for rubber compounding, have alleviated, if not allayed, the cracking. With the solution of the cracking problem the way will be cleared for higher dosages of carbon and so still better wear.

PART II—ITS CAUSE

Surface Energy

No doubt exists as to the relationship between reinforcement and surface development, but the published attempts to explain this relationship in terms of surface energy or free surface energy changes are often confusing and even contradictory.

It is important therefore to begin by examining the available alternatives and their implications.

Case I

Reinforcement is due to Increased Free Surface Energy. This implies that the generation of a rubber pigment interface involves increased, reversible, mechanical work, and therefore that the increased work of rupture (reinforcement) as a specimen is stretched is likewise due to, and accompanied by, a progressive *increase* in rubber-pigment surface boundary. Such a condition has never been demonstrated, never suggested, and can scarcely even be imagined. All of the known facts regarding rubber fillers in general point in the opposition direction, viz., a tendency towards separation of rubber from pigment, i.e., a *decrease* in interfacial boundary.

Case II

Reinforcement is due to Decreased Free Surface Energy. This implies that the generation of a rubber-pigment interface, like adsorption, is accompanied by a decrease in free surface energy, and therefore that the increased work of rupture is due to, and accompanied by, a progressive *decrease* in rubber-pigment interface, i.e., a separation of pigment particles from their rubber matrix. At first blush this view would seem more plausible than Case I. Unfortunately, there is no experimental evidence that in the case of reinforcing pigments there is any such separation. A study of Schippel's data reveals that in the case of carbon black up to 30 volumes and in the case of zinc oxide up to 75 volumes, the volume increases on stretching were actually less than that of the base mixing! Again, there is no proof that, even at rupture, a specimen of reinforced rubber fails at the pigment boundary. Finally, as Barron and Cotton *(1)* have shown, the work of rupture of carbon reinforced rubber is eighty per cent non-reversible, whereas free surface energy changes are, by definition, reversible phenomena.

Opinions on Mechanism of Reinforcement

With these considerations in mind let us briefly review some of the published opinions on the mechanism of reinforcement.

Wiegand in 1920 *(2)* wrote: "Schippel's results throw a clear light on the mechanism of the reinforcement action of the finer pigments. These resist increase of the free surface energy necessary to separate them from their rubber matrix. When a carbon black stock is stressed to rupture the work done on the rubber phase must be increased by an amount representing the increase in surface energy required to separate each particle of carbon from its surrounding phase of rubber."

Here is a clear, not to say categorical, exposition of Case II—the Low Free Surface Energy Concept. Wiegand made two assumptions, first, that failure occurs at the rubber-pigment boundary, and second, that the increased proof resilience (work of rupture) is meas-

(1) Barron and Cotton, *I.R.I.*, 7, 209 (1931).
(2) Weigand, *I.R.W.*, Oct. 1, 1920, pg. 18.

ured by the increase in surface energy required to separate rubber from pigment. So far as the writer is aware neither of these assumptions has been substantiated during the intervening seventeen years!

Parkinson in 1929 *(3)* wrote: "The larger the surface the greater is the boundary surface energy or inter-facial tension between the filler and the rubber matrix. In addition to this, as the particles get smaller their intrinsic free energy becomes greater owing to their high degree of curvature, a greater proportion of each molecule lying outside the surface, so that a greater proportion of its energy is available as free surface energy. The effect of very small particles, therefore, is to increase the free energy not only by increasing the surface, but by increasing the energy per unit area of surface."

Here we see Case I invoked. Later, the same author says: "It is considered by some investigators that rubber itself is adsorbed by carbon black, in other words that the bond presumed to exist between rubber and filler is in the nature of an adsorptive attachment. . . ."

By this reference to adsorption Parkinson tacitly changes over to Case II, the opposite condition to Case I, and to make his position completely impregnable he shrewdly adds: "To say that a filler reinforces because its particles possess a large amount of free surface energy is no explanation at all, but the idea provides a basis from which, as knowledge progresses, it may be possible to build up satisfactory theories on what appears to be a complicated phenomenon."

Cotton in 1930 *(4)* writes: "The weight of available evidence indicates that the valuable properties imparted by reinforcing fillers are directly attributable to the increase in surface energy of the compound." And again: "The work of rupture has to overcome (a) forces of adhesion, (b) the interfacial tension, (c) friction between flocculated particles of filler, (d) plastic flow around the filler particles."

There would seem no question as to the validity of items (c) and (d) as mentioned by Cotton. However, when Cotton asks us to believe that the work of rupture is called upon at the same time to overcome the forces of adhesion and, their opposite, the interfacial tension, we are placed in a serious quandary. The interfacial tension acts to decrease the rubber-pigment interface which the forces of adhesion seek to prevent! Under such circumstances the natural thing for the work of rupture to do would seem to be to stand aside and allow (a) to overcome (b), and vice versa!

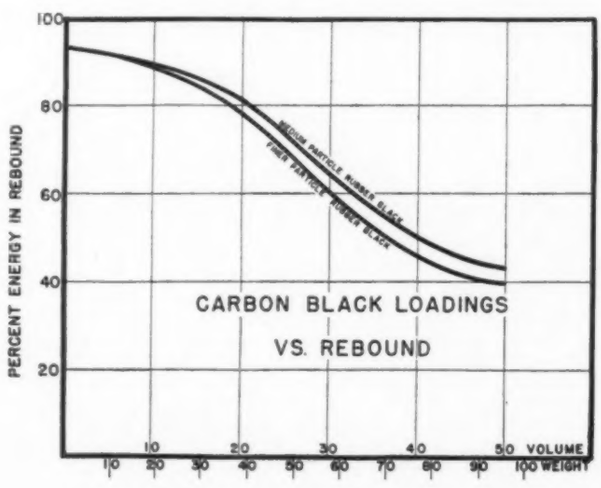


FIGURE 3—Carbon Black Loadings vs. Rebound.

Lefcaditis *(5)* gives his views as follows: "On reinforcement by a filler such as carbon black, for which a multitude of facts indicates high attractive force towards rubber, the increased work required for the extension of the compounded rubber to rupture is consumed to overcome (i) the high free surface energy of the system, which is opposed to separation of the two phases, and (ii) a component which will be assumed of complicated nature." Here again we note the use of the high free surface energy hypothesis without regard to its implication. A high free surface energy would not be opposed to a separation of the two phases, but would on the contrary permit it.

Our final quotation is from the latest text-book on rubber technology by Hauser *(6)*. (The translation is by the writer.) "The explanation of the phenomenon (reinforcement) would then be as follows: The development of such a surface requires work which, ***inter alia***, must be exerted against the surface tension of the rubber (i.e. its natural tendency to diminish its surface). A part of this work is stored up in the form of reversible free surface energy. During the rupture of the reinforced specimen, on the other hand, the interfacial boundary between rubber and filler must be dissolved, and so additional mechanical work must be done."

Here we have an example of the high free energy assumption being invoked simultaneously with conditions requiring the low free energy assumption. In other words, we are told that a part of the work required to generate the pigment interface will oppose its dissolution!

So much for what might be called the speculative use of the surface energy concept.

Thermodynamical Studies of Hock and His Co-Workers

Although also accepting the view that the reinforcement of rubber with fine pigments was a function of the free surface energy, it stands to the credit of Hock that he sought to apply quantitative thermodynamical methods to this study. Reduced to simplest terms the essence of Hock's method of attack was as follows: The heat of wetting of rubber in, for example, benzine being known, and the heat of wetting of carbon black also being known—an unvulcanized compound of rubber and carbon black was permitted to swell and the heat tone determined. The extent to which the heat tone differed from the algebraical sum of the heats of wetting of the two components was taken as a measure of the total energy required to separate rubber from pigment. This was then calculated back to unit content of reinforcing pigment. Hock calls it Heat of Adhesion or "Heat of De-Wetting".

Initial results seemed promising. It was found that heat absorption occurred during the swelling of the rubber-carbon black mixing and, when calculated back, an order of magnitude agreement was obtained with values for resilient energy taken from Wiegand's papers.

There are, of course, many sources of error and doubtful points of interpretation in such a method of attack and it is only fair to Hock to say that he himself has recognized practically all of them in his 1934 paper *(7)*. In order to facilitate discussion, Hock and

(3) Parkinson, *I.R.I.*, **5**, 263 (1929).
(4) Cotton, *Ibid*, **6**, 248 (1930).
(5) Lefcaditis, *Ibid*, **9**, 67 (1933).
(6) Hauser, "Handbuch der gesamten Kautschuktechnologie," 1, 218.
(7) Hock, *Rub. Chem & Tech.*, **7**, 462 (1934).

Hartner's data for carbon black have been recalculated. All energy values have been reduced to the same units and the course of the reinforcement, or A function, for carbon black referred to the same abscissa as the various heat tone values obtained. The following points require mention:

(1) The course of the heat of adhesion values as calculated by Hock does not in any way conform with the trend of the A function.

(2) The values for heat of adhesion do not conform even in order of magnitude with those actually obtained in the reinforcement of rubber with carbon black.

(3) Pure rubber itself can show secular changes in the amount of heat absorption incurred during swelling, which are greater than any of the heat tone effects obtained in the experiments.

(4) The calculation of "heat of adhesion" from the algebraic sum of the heat of wetting of the rubber and that of the carbon black involves the assumption that the carbon black has been severed from the rubber and completely wetted by the solvent. This would scarcely seem warrantable in view of the experiments of Stamberger, Goodwin and Park, Menadue, Boire and others which indicate that the bond between rubber and carbon black is stronger than that between either and the solvents customarily employed.

(5) The approximation of the heat tone of the compounded rubber to that of the rubber alone, except for slightly higher values, taken in conjunction with the still higher values shown for crude rubber which has been allowed to recover after milling, and taken also in conjunction with the well-known setting up effect of carbon black on crude rubber and on reclaimed rubber *(8)* which has been heavily milled, suggests that the positive heat tone of the rubber-carbon black compound when swelled in benzine may have been due not to the dissolving of the rubber-pigment interface, but to a change in the rubber phase, through the instrumentality of the carbon black in what might be termed an "accelerated recovery effect."

(6) Finally, there is of course the difference between uncured and cured mixings, to say nothing of the ever present doubt as to whether the work of rupture is even remotely related to dissolution of the rubber-pigment interface.

In the writer's opinion both the experimental technique and the thermodynamical method of approach of Hock and his pupils are in themselves sound. Their work ought to be supplemented by additional experimental determinations under varied conditions, and the final results correlated not with the values for the initial work of extension of reinforced rubbers but with reversible energy values obtained under "dynamic" conditions.

This brief review of surface energy theories in relation to rubber reinforcement will serve to illustrate the unsatisfactory state of our knowledge.

The Work of Incorporation

It would appear that apart from confusion as to sign in the expression "high free surface energy" and a failure to recognize its implications, there has been also a persistent tendency to equate, at least in part, the mechanical work of incorporation of a pigment with the free surface energy of its newly acquired rubber boundary *(6)*.

There is no evidence that they are even remotely related. In a tire tread the incorporation of one pound of carbon black in two pounds of rubber necessitates spreading this unvulcanized rubber over approximately ten acres of surface. From the moment any of the carbon black particles have been dispersed, *reinforcement has already begun even in the uncured rubber;* thus as mixing proceeds the viscosity progressively increases as the zones of reinforced rubber extend throughout the whole matrix.

The more efficient the reinforcing action of any particular grade of carbon black in vulcanized rubber the greater is found to be its stiffening action on the raw stock. Thus, in the opinion of the writer, the increased work of incorporation of reinforcing pigments may be simply, if prosaically, explained. It has raised the entropy of the universe in the form of frictional heat!

(To be continued)

(8) Winkelmann and Croakman, J.I.E.C., **20**, 134 (1928).

Latex-Bitumen Joint Filler

COMBINING latex and bitumen, an improved joint filler was recently developed and tested in new and old concrete paving by the laboratory of the California Division of Highways, under the direction of Thomas E. Stanton, Jr., materials and research engineer. The filler is said to possess the essential characteristic of stickiness, combined with little or no tendency to flow at high temperatures and high ductility at low temperatures.

During early tests, best results were obtained with a mixture of approximately 70% soft-grade, slow-curing road oil and 30% of commercial latex. To avoid foaming of the latex, mixing temperatures were maintained at 200° F. The source of the road oil proved important, since two oils of the same grade, but from different sources, gave quite different results.

A bond and seal attained at the time of installation was maintained through five months of the test and gives indication of holding up well throughout the balance of the winter and subsequently, according to report. The joint filler cost approximately $61 per ton, the latex by far being the more costly ingredient. For crack filling, gasoline and similar solvents were used as a cutback with the road oil to produce the desired consistency, depending upon the widths of the cracks.

All work in developing the combined latex and bitumen filler was done by Harry S. Bennett, asphalt testing engineer, and Robert Gillis, chemical testing engineer, both associated with the Materials and Research Department, California Division of Highways, San Francisco.

Polish Rubber Industry

THE Polish rubber manufacturing industry, which dates only from 1920, since prior to the World War there was only one factory in the country, had 34 concerns in 1933, employing approximately 9,000 workers. The first company established in 1920 produced rubber footwear only, but rubber products currently produced include tires and tubes, soles and heels, drug sundries and miscellaneous items. Rubber footwear production, however, amounts to more than half of all rubber products. In 1927 a total of 2,800,000 pairs were produced; 6,300,000 pairs in 1930; 9,600,000 pairs in 1934; and 7,176,000 pairs in 1935. The drop in the 1935 figure is accounted for by shrinkage of the country's export markets due to Japanese and Czecho-slovakian competition, according to American Commercial Attaché George R. Canty, stationed in Warsaw.

The Effect of Cure and Temperature of Flexing on the Flex Resistance of a Conventional Tread Stock

By M. F. Torrence

Rubber Chemicals Division, Organic Chemicals Dept.,
E. I. du Pont de Nemours and Company, Incorporated

IN the past few years probably nothing has demanded more of the tire compounder's attention than has flex cracking, its causes and its prevention. Neal and Northam *(1)* have shown that oxidation is a very important factor in causing flex cracking. Some other investigators *(2)* have shown a very close correlation between the mechanical fatigue characteristics of a stock and its cracking tendencies. It is well known that the state of cure, as well as the temperature of testing, has a definite effect upon both the aging and such physical properties as moduli, resistance to tear and tensile strength, etc., of vulcanized rubber. It is quite natural then for the compounder to make some prophecies concerning flex cracking based on this knowledge. The result has been that a great number have taken it for granted that over-curing causes bad flex cracking and that vulcanized rubber cracks more rapidly at elevated temperatures than at lower temperatures.

The results of the tests given in this paper appear to disprove these beliefs and show that a typical tread stock will actually flex crack less when over-cured or when flexed at elevated temperatures than when normally cured or flexed at room temperature. It is a fact that stocks aged in an oven at elevated temperatures flex crack more rapidly than do unaged stocks. This accelerated aging takes place during flexing at elevated temperatures and, if the flexing period is long or the stocks are unaged at the start, the effect of aging will over-shadow the effect of the testing temperature. In order to prevent this the stocks were all aged for 14 days in a 70° C. circulating air oven. The over-curing herein referred to is limited to that obtained by vulcanizing for a longer period of time than is necessary to reach the optimum physical properties, judged by the time tensile curve, and does not apply to characteristic types of over-cures that are obtained by raising the temperature or by increasing the quantities of such curing ingredients as sulfur, accelerators and activators. In fact, a very different picture may result when this is done.

The following conventional tread stock was used for the base recipe:—

Rubber	100.0
Zinc Oxide	5.0
Channel Black	47.5
Stearic Acid	3.0
Pine Tar	1.5
Mercaptobenzothiazole	1.0
Sulfur	3.0

To this base recipe there were added the antioxidants as shown in Tables I and II.

This paper was presented at the meeting of the Rubber Division, A. C. S., held in Pittsburgh, Penna., September 10-11, 1936.

The rates of cure were essentially the same for all stocks with the exception of Compounds 1231-124 and 1231-159, which had a slightly slower rate of cure than the others. These two stocks are the first ones listed in Tables I and II, respectively. Fifty minutes at 274° F. (134.4° C.) gives a slight under-cure on these two stocks but is close to the optimum state of cure on the others. The 70- and 150-minute cures are over-cures on all the stocks.

Masticated prime ribbed smoked sheet was used for the stocks listed in Table I and specially selected first-quality pale crepe was used for the stocks listed in Table II. The pale crepe was used to eliminate the dirt factor as much as possible because it was observed that the effect of foreign material is more pronounced in starting cracks when the stocks are flexed at elevated temperatures than when they are flexed cold. It was also noted that the effect of surface marking was similarly modified by increasing the temperature. At the elevated temperature the cracks are fewer but larger.

All samples were cured the indicated time and temperature and aged 14 days at 70° C. in a circulating air oven before they were flexed. The testing was done on the belt type flexing machine per Method C, A.S.T.M. Designation D-430-45T. For testing at elevated temperatures the flexing machine was enclosed in a cabinet equipped with an electric heating element and a DeKhotensky temperature control unit.

Belt type flexing machine with the cabiner removed to show the arrangement of pulleys and test pieces.

TABLE I

Stock No.	Antioxidants		RATING AFTER FLEXING: 130 hours at Room Temp. (26° C.) 50′ @ 30 lbs.	130 hours at Room Temp. (26° C.) 70′ @ 30 lbs.	144 hours at 55° C. 50′ @ 30 lbs.	144 hours at 55° C. 70′ @ 30 lbs.	209 hours at 55° C. 50′ @ 30 lbs.	209 hours at 55° C. 70′ @ 30 lbs.
1231–124	Condensation product of acetone and diphenylamine	2.0 %	7	3½	1¾	3½	4	6
1231–125	Diphenyl para phenylene diamine Dimethoxy diphenylamine Phenyl beta naphthylamine	0.25 % 0.25 % 1.5 %	3¾	2	3½	¼	6	2
1231–126	Dimethoxy diphenylamine Phenyl beta naphthylamine	0.375% 1.625%	9	8¾	4	2½	7	4
1231–127	Dimethoxy diphenylamine Phenyl beta naphthylamine	0.5 % 1.5 %	5	6½	1¾	2½	3	3
1231–128	Dimethoxy diphenylamine Phenyl beta naphthylamine	0.75 % 1.25 %	3¾	2¾	1¾	¾	2½	2½
	Average of five stocks. 50′ @ 30 lbs. taken as 100%		100%	82	43	33	79	61

Duplicate test pieces were run in all cases and the average of the two pieces was reported.

Table I gives the results of flexing tests on five tread stocks cured 50 and 70 minutes at 274° F. These stocks contained smoked sheets and various antioxidants as indicated. The degree of cracking is expressed in units from 0 to 10. A sample is rated 10 when it is cracked completely across in all grooves. Zero rating indicates no cracking. Samples were flexed at room temperature (26° C.) and the degree of cracking was recorded after 130 hours testing. Duplicate samples were flexed at 55° C. and the degree of flex cracking was observed after flexing for 144 hours and after flexing for 209 hours. In averaging the results the average of the 50-minute cures flexed at room temperature was taken as 100% and the ratio of the other averages to that, was expressed in the corresponding percentages. In other words each vertical column was averaged, these averages divided by the average of the first column and the results multiplied by 100 to give percentage figures.

In every case flex cracking was more rapid at room temperature (26° C.) than at 55° C. The average amount of cracking of the five stocks when flexed 144 hours at 55° C. is less than half as much as when they are flexed 130 hours at room temperature (26° C.). It should be noted, however, that Compound No. 1231-125, which shows up very well at room temperature, is practically no better at the elevated temperature. Stock 1231-128 shows the same characteristics to a less extent. This seems to indicate that stocks which flex poorly at normal temperature are the most affected by differences in testing temperatures. This is further evidenced by the results listed in Table II, which covers a larger number of antioxidant combinations.

The averages also show a definite decrease in cracking when the stocks are over-cured. Each stock behaves in this manner except 1231-124, when flexed at 55° C., and 1231-127, when flexed both at room and elevated temperatures.

Crawford *(3)* stated that years of experience indicate that increasing the cure beyond the optimum tends to decrease the flex cracking resistance and gives two examples where this was true in an aldehyde amine accelerated stock. If it is assumed that this experience has been primarily with this type of compounds and if the results of the two examples are taken as representative, it will be necessary to limit the conclusions drawn from the results of tests outlined in this paper to a benzothiazole type stock containing one or more of the several age resistors investigated.

The stocks listed in Table II contained pale crepe in place of smoked sheets in order to eliminate, as

(Continued on page 368)

TABLE II

Stock No.	Antioxidants		RATING AFTER FLEXING 219 HOURS AT Room Temp. (28° C.) 50′ @ 30 lbs.	Room Temp. (28° C.) 70′ @ 30 lbs.	Room Temp. (28° C.) 150′ @ 30 lbs.	55° C. 50′ @ 30 lbs.	55° C. 70′ @ 30 lbs.	55° C. 150′ @ 30 lbs.
1231–159	Condensation product of acetone and diphenylamine	2.0 %	12*	10	8¼	8¼	8½	7¾
1231–160	Diphenyl para phenylene diamine Dimethoxy diphenylamine Phenyl beta naphthylamine	0.25 % 0.25 % 1.5 %	6	3¼	0	4	3	3
1231–161	Dimethoxy diphenylamine Phenyl beta naphthylamine	0.375% 1.625%	7½	1¼	3½	5¼	4½	3¼
1231–162	Dimethoxy diphenylamine Phenyl beta naphthylamine	0.5 % 1.5 %	6	2¼	½	5	1¾	0
1231–163	Dimethoxy diphenylamine Phenyl beta naphthylamine	0.75 % 1.25 %	1¾	3½	¾	0	¼	½
1231–164	Diphenyl para phenylene diamine Dimethoxy diphenylamine Phenyl beta naphthylamine	0.375% 0.375% 1.25 %	3	1¾	0	2¼	3¼	0
1231–165	Diphenyl para phenylene diamine Dimethoxy diphenylamine Phenyl beta naphthylamine	0.375% 0.875% 0.75 %	2	2¼	¾	2¾	4	2
1231–166	Diphenyl para phenylene diamine Dimethoxy diphenylamine Phenyl beta naphthylamine	0.25 % 0.75 % 1.0 %	3	1¾	¾	2½	¾	1

* Completely cracked after 182 hours flexing. $\left[12 = \frac{219}{182} \times 10.\right]$

Rubber Division, A.C.S., Meeting at Chapel Hill

Fourteen Papers Are Scheduled for Presentation at Two-Day Session, Including a Report from the Crude Rubber Committee

FOURTEEN papers, including a report from the Crude Rubber Committee, will be presented at the semi-annual meeting of the Rubber Division, A.C.S., which will be held next month at the University of North Carolina, in Chapel Hill, North Carolina, in conjunction with the 93rd meeting of the Society. The rubber meetings will be held on Wednesday and Thursday, April 14th and 15th, with seven papers scheduled for delivery at the first session, the balance at the second. As usual, the first session will be held in the afternoon, and the second in the morning of the following day. The banquet will be held on the evening of April 14th. Details of the meeting rooms or banquet location have not yet been announced.

Although no hotel rooms will be available in Chapel Hill during the A.C.S. meeting, ample accommodations are being provided in the numerous dormitories, fraternity houses and in private homes. For general convenience, those who plan to spend only one night at the convention (such as most members of the Rubber Division) are urged to use Durham hotels rather than Chapel Hill accommodations. For such members, reservations may be made directly with the Washington-Duke, or the Malbourne Hotel, Durham, N. C. Durham is only a short distance from Chapel Hill and arrangements are being made for transportation facilities.

Abstracts of thirteen of the fourteen papers (the missing one represents the report of the Crude Rubber Committee), together with the names and company connections of the authors, following herewith:

ABSTRACTS OF PAPERS

Frosting of Vulcanized Rubber. ***By W. F. Tuley (Naugatuck Chemical).***

Frosting is a descriptive term for a particular type of dulling of the surface of vulcanized rubber articles which occurs most frequently in warm, humid weather. Rubber vulcanized in a mold, in steam or in air will frost but the effect is most noticeable on the bright finish of air cured products. Frosting is a microscopic disintegration of the surface caused by ozone in the air and its action on the rubber is favored by warmth and humidity. Frosting can readily be reproduced in a laboratory test. It is prevented by protective films such as lacquer or varnish; by treatment after vulcanization with chlorine or bromine or sulfur monochloride; or by incorporating in the rubber before vulcanization certain types of high melting petroleum waxes or one of the "anti-frosting" agents of which p, p'-diamino diphenylmethane is the most effective.

The Effect of Temperature and Mill Roll Opening on the Extrusion Qualities of Rubber. ***By A. H. Nellen (Lee Tire).***

A specially designed laboratory tubing machine is described, which is used as a plastometer for determining the plasticity of extrusion qualities of various samples of smoked sheet rubber which were milled on the laboratory mill under varying conditions of temperature and mill roll setting, as well as on samples which have been passed through a tubing machine at various temperatures. The procedure used in this plasticity determination is described in detail.

The data obtained indicates that the method described accurately determines the relative plasticity or extrusion qualities of rubber. Within the limits of temperatures studied, the lower the temperature, the softer the rubber becomes. Within the limits of mill roll openings studied, the tighter the mill, the softer the rubber becomes.

High Speed Vulcanization of Rubber. ***By A. R. Kemp and J. H. Ingmanson (Bell Telephone Laboratories).***

The continuous vulcanizing process now employed by the rubber covered wire industry involves the use of very active accelerators and vulcanizing temperatures considerably above those normally employed by the rubber industry.

This paper supplies the need for data on the temperature coefficient of vulcanization velocity and quality of the product obtained at vulcanizing temperatures ranging from 170° to 198°C. It is shown that in calculating vulcanization rates for high temperatures a time correction should be applied in order to correct for the heating-up period. The average 10° C. temperature coefficient in this temperature range was found to be 2.16. Compounds vulcanized at 170° to 198° C. appear to be at least equal, in physical and aging properties, to the same rubber compositions vulcanized at 142° C.

Notes on Determination of Free Carbon in Rubber Goods. ***By E. W. Oldham and J. G. Harrison, Jr. (Firestone).***

A survey of the methods proposed for carbon black determination shows that the nitric acid decomposition of the rubber sample is the simplest method and accurate enough for technical purposes. The following improvements upon this method are recommended: decreasing the size of the sample; omitting the preliminary extraction of the sample; using an intermediate wash of acetic acid, acetone, and chloroform between the nitric acid and acetone and chloroform; and correcting the results when clay is present.

An Apparatus for the Evaluation of Rubber and Rubber-Like Compositions as Vibration Absorbers. ***By Felix L. Yerzley (Du Pont).***

The importance of both static and dynamic tests of materials to be used as vibration absorbers is stressed. A test apparatus is described which yields information on both static and dynamic properties in the form of an autographic record of damped oscillations. The equipment is compact, simple, and rugged and can be used over a range of temperatures. It provides a means of evaluating stocks at intervals during aging or mechanical life tests. Examples of test data are presented to show the evaluation of dynamic hardness, static hardness, dynamic modulus, internal friction, and drift.

Colloidal Structure of Rubber in Solution. ***By S. D. Gehman and J. E. Field (Goodyear).***

Measurements are reported of the intensity and depolarization of the light scattered transversely by solutions of purified rubber in various solvents. Viscosity measurements on the same solutions are included.

Experimental results are compared with the expectations

on the basis of various theories of light scattering. It is shown that the scattering is best explained by assuming in the solutions a loose structure of anisotropic scattering units large compared to the wave length of light and similar in nature to the cybotactic groups of a liquid.

A method for the determination of the relative molecular weight of rubber in solution by light scattering measurements is compared with the viscosity method of Staudinger and the two methods found to be consistent.

Purified Rubber for Electrical Insulation. ***By A. R. Kemp (Bell Telephone Laboratories).***

This paper presents information on the nature and role of the non-hydrocarbon constituents in latex and plantation rubber with special emphasis on their effect on water absorption and dielectric properties.

Rubber from latex after nine centrifuge creamings was found to be ash free and contain 0.056 per cent nitrogen, corresponding to 0.35 per cent protein present as a highly absorbed layer on the latex particles.

It is shown that soluble substances rather than proteins are mainly responsible for the absorption of water by rubber, which is in accordance with the Williams and Kemp osmotic theory.

Various methods for purifying rubber are described and data on the composition and properties of the products are presented. Rubber purified by heating crepe in ammonia vulcanizes and ages satisfactorily, and is shown to have a low moisture absorption and a high degree of dielectric stability in water.

Unsaturation of Rubber Vulcanized with Nitro Compounds and Benzoyl Peroxide. ***By John T. Blake and Philip R. Bruce (Simplex Wire & Cable).***

The unsaturation of rubber vulcanized with nitro compounds and benzoyl peroxide has been studied by means of iodine chloride. Results are given that are somewhat similar to those obtained previously with iodine bromide. The data are at variance with those obtained some years ago by Fisher and Gray and lend additional support to the chemical theory of vulcanization.

Calculations have been made of the number of double bonds saturated by the nitro compounds and benzoyl peroxide. A molecule of the latter appears to saturate about one double bond — as sulfur does. The nitro compounds saturate more than one bond and quantitatively this needs further study.

Scattering in the Near Infra-Red as a Measure of Particle Size and Size Distribution. ***By D. L. Gamble and C. E. Barnett (N. J. Zinc).***

The present methods of measuring the particle size and size distribution of powders are reviewed and the need of a new method shown. Such a method based upon the transmission of suspensions at various wave lengths in the visible and near infra-red regions is described. From the shape of the spectral transmission curve obtained, the relative average size and size distribution characteristics of powders can be estimated.

Impact Resilience in the Testing of Channel Black. ***By J. H. Fielding (Goodyear).***

Resilience of cured tread type stocks as determined by an impact pendulum has been applied to the testing of channel black of rubber quality. Typical frequency curves are presented. Resilience is found to be related to the blackness of the black and to the toughness it produces in the uncured stock. These three properties, therefore, agree within the range of rubber channel black as well as over the broader range of black from the soft blacks to the color blacks. Its relation to particle size is illustrated by the two other tests which are considered qualitative only.

Influence of Metallic Oxides on Certain Physical Properties of Neoprene. ***By Howard W. Starkweather and Herbert W. Walker (Du Pont).***

The use of compounding ingredients is not essential to the conversion of plastic to non-plastic neoprene, but the addition of suitable materials does effect the properties of both the plastic and the cured neoprene. In this report data are presented showing the influence of metallic oxides on the stability of uncured neoprene and on the stress-strain properties, hardness and water absorption of cured neoprene. It is shown that proper mixtures are more effective than single oxides. The best compounds for general use contain ZnO and MgO. CaO cannot be substituted for MgO. Mixtures of PbO and MgO or ZnO give compounds which have low modulus and tensile strength, but which, with the proper selection of oxides, possess superior water resistance.

Litharge as Accelerator for Chloroprene Plastic Polymer. ***By W. J. Clapson (Eagle-Picher).***

Litharge is compared with basic carbonate white lead, zinc oxide and magnesia as accelerator for the chloroprene plastic polymer Neoprene Type E in stocks loaded with 100 parts soft carbon black. Basic carbonate white lead behaves similarly to litharge but is slower in set up. The effect of sulfur, wood rosin, stearic acid, pine tar and lead oleate on cure, and of certain of these on water-, gasoline- and kerosene-absorption with litharge and with magnesia is discussed. Litharge gives good resistance to gasoline and kerosene; it is particularly effective in conferring low water-absorption.

Rebound Pendulum Machine for Determining the Elastic Efficiency of Rubber. ***By George J. Albertoni (Goodyear).***

A description is given of a machine of the pendulum hammer type for the measurement of the elastic efficiency of soft rubber. A new device for recording the exact rebound height is described, a device which can be made to operate at different magnitudes of work input. A new micrometric arrangement to determine, by electric contact, the penetration of the pendulum hammer into the rubber, is described. A comparison is outlined between rebound results and the results obtained by the ordinary hysteresis curves, when determined at constant work input.

Safety Control for Rubber Mill

A CONTROLLER installed recently in the Passaic (N. J.) plant of the Okonite Company, decreases the stopping time of calenders and mills and has proved a valuable safety measure. To stop the rolls, the workman touches a long bar which causes a breaker to open the line circuit and operates another breaker to initiate regenerative braking. A special study resulted in additional safety measures by coordinating the apparatus to provide quicker stopping. The operating time of one breaker was decreased by mechanically interlocking the running breaker and the regenerative breaker. The safety switch opens the running breaker, which simultaneously causes the regenerative breaker to be closed by a powerful spring. Principally, the operating time of one breaker was eliminated by having the safety bar operate to close the regenerative braking circuit breaker at the same instant it opens the line breaker. The time saved, according to report, means a difference of several inches in the travel of the calender rolls.

Picture-Printing on Rubber

BY MEANS OF a recently-developed liquid sensitizer it is now possible to reproduce actual photographic prints upon rubber surfaces, as well as paper, fabric, leather and other surfaces. The picture prints are made direct from the original negative. Known as Trans-Pix, the liquid material sensitizes the surface upon which it is applied, with sunlight or photoflood exposure being sufficient to produce the picture. Once reproduced, the picture remains permanently upon the surface and is not affected by washing, additional exposure, etc. Sold in kit form, Trans-Pix is a product of the Ador-Transfoto-Nega-Print Company, 50 East Fordham Road, New York City.

Xaloy—A New Metal Alloy

USED in oil well equipment for some time with success, Xaloy, a metal alloy, is now being made available to broader fields by the Wilcox-Rich Division, Eaton Manufacturing Company, Detroit, Michigan, under license from Industrial Research Laboratories, Ltd. This alloy has a tensile strength of 43,000 pounds per square inch and a compression strength of 240,000 pounds per square inch, and is most suitable where its hardness and resistance to abrasion can be used to advantage and where high impact values and ductility are not important. Its hardness is equivalent to 750 Brinell or 68 to 70 Rockwell C scale.

The metallurgical properties of Xaloy, according to Wilcox-Rich, recommend it for application as a lining or coating to bushings or rollers on equipment subjected to the abrasive wear of materials, such as that used in certain rubber processes. One such use was as a coating on the periphery of rolls used to slit rubber fabrics. High speed steel rotary knives operate on the surface of these rolls and, since facing the rolls with Xaloy, the company reports a considerable increase in surface life. Another advantage cited in this instance is the fact that the rolls may be removed, the surface refinished, and the rolls remounted. This may be repeated a number of times, prolonging the life of the rolls, according to Wilcox-Rich engineers.

Nevillite Oil—Odorless Plasticizer

DEVELOPMENT of Nevillite Oil, described as a colorless hydrocarbon oil, has been announced by the Neville Company, Pittsburgh, Pennsylvania. It is an improved water-white plasticizing and solvent oil, neither a hydrocarbon resin solution nor a soft resin, but a separate treated polymer having a viscous liquid consistency, and is non-volatile for all practical purposes. It is especially useful as a plasticizer for chlorinated rubber coatings, rubber resin finishes, waterproofing compositions, and wherever an unsaponifiable, neutral substantially non-drying oil is required.

Used with chlorinated rubber coatings (Tornesit), Nevillite Oil blends readily with the other components and imparts good flexibility and chemical resistance, according to the company, the coating being rendered unusually resistant to breakdown by water, alkalis and dilute acids. It can also be utilized to modify coatings based on crepe rubber resin (Pliolite), which require a certain amount of plasticizer.

Raw Rubber Coating for Pipes

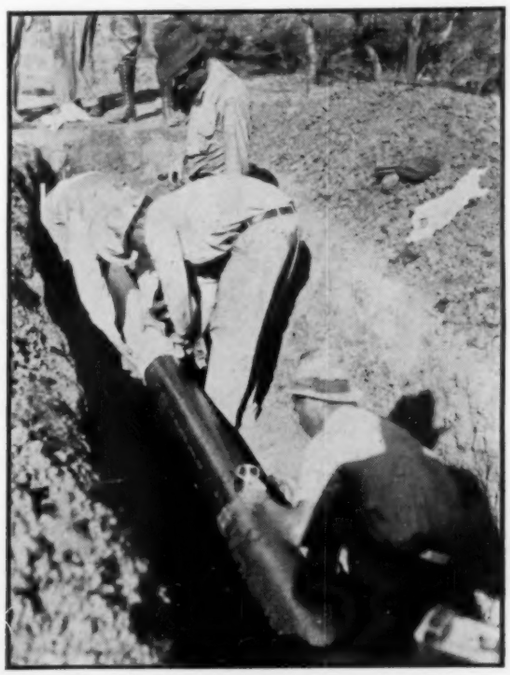
TWO pipe line companies in Texas are currently conducting experiments with raw rubber coatings to prevent pipe line corrosion, according to a recent issue of the *Oil and Gas Journal*. The raw rubber has a thickness of 20 mils only, is wrapped on the pipe in the ditch or as the pipe is taken out of the ditch for reconditioning, and is spirally wrapped around the pipe, lapped half over so that it forms a covering 4/100ths of an inch in thickness. Due to stretching, it is reported that a true thickness of only 38/1000ths of an inch is obtained.

Before the rubber is wrapped on the pipe, the pipe is thoroughly cleaned and all pits spot-welded if necessary. An adhesive rubber cement is thoroughly applied to the pipe, allowed to dry about 10 minutes and then the rubber is wrapped over it, the cement bonding the rubber to the pipe. The rubber is applied in strips, with no cement used between the strips, the raw rubber bonding itself as it cures. A curing solution is painted over the rubber wrapper by hand and the line is allowed to lay in the open for 24 hours to cure before being placed in the ditch and before backfilling.

One company has placed this new type of coating on 16 feet of 6-inch line in Archer County, North Texas, an area considered a "hot spot", where corrosion is excessive due to soil and other conditions. Another concern is experimenting on its lines in South Texas. It is pointed out that synthetic rubber is especially suitable for coverings of this type due to its oil resistance, but that the lower cost of raw rubber justifies its use, with special care being taken to prevent line leaks from seeping oil down to the rubber wrapping.

[Photos, courtesy of *Oil and Gas Journal*]

Raw rubber wrapped around a pipe to prevent corrosion.



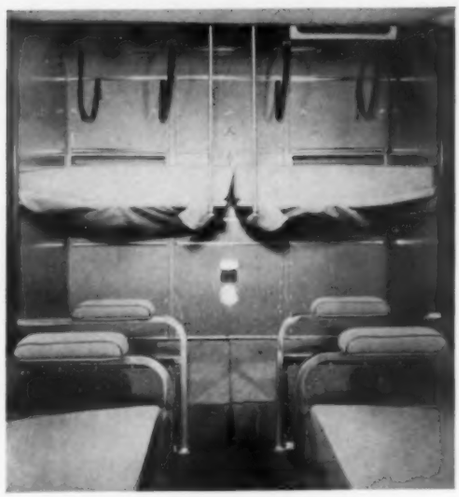
Painting the curing solution over the rubber.

Rubber in the Budd Sleeper Bus

RUBBER plays an important part in passenger comfort and ease of operation of a new light-weight, stainless steel sleeper bus of 14-passenger capacity, recently delivered by the Edward G. Budd Manufacturing Company, Philadelphia, Penna., to the Nairn Transportation Company, Ltd., for use in the Syrian Desert, between Baghdad and Damascus. Construction of the special bus, which is air-conditioned and the first of its kind ever constructed, closely follows the design of railway equipment built by Budd.

The bus comprises a tractor and trailer. The tires on the trailer were built especially by Firestone and are 300 x 20 in size (the 300 refering to millimeter and the 20 to inches). They are special low pressure tires having only 10 ply instead of the 14 ply common to this size, and are capable of running on 20 to 25 pounds air pressure. The bus makes use of a fifth wheel, described as "a specially constructed pneumatic arrangement incorporating rubber to absorb road vibration." Two spare tires are carried in the tractor unit.

Both the cab and the tractor body are individually mounted on 4 point suspensions, each of which has two stationary points and two points "floating" on rubber to absorb the wracking of the tractor frame. Since the tractor cab and body are separately mounted, a sheet of rubber connects the two so that no stresses will be set up in the body from twisting. To give the appearance of a continuous unit, the rubber sheet is the same color as the body of the tractor.



Sponge rubber cushioning features the seats and arm-rests in the Budd 14-passenger sleeper bus.

Following the growing trend in bus and rail transportation, the trailer of the sleeper bus makes use of sponge rubber cushioning for both the seats and mattresses. Berths are made up in practically the same manner as on pullmans. Because of the dust problem which exists in desert areas, the windows and doors of the bus are thoroughly sealed with rubber strips, assuring passenger protection.

Effect of Cure and Temperature

(Continued from page 364)

nearly as possible, the dirt factor. The first five stocks are the same as those in Table I, except for this item. An additional cure (150 minutes) was added to determine the effect of very long over-cures.

Although there are several very inconsistent results in Table II, the majority of the stocks show that a state of over-cure and testing at elevated temperatures improve the resistance to flex cracking. Even the long 150-minute over-cures show up better than either the optimum cures or the 70-minute over-cures. These inconsistencies, some of which are underlined, and the fact that many of the samples have cracked so little that an accurate evaluation is difficult makes the average of the results meaningless. They are, therefore, not given.

If a comparison of the results in the two tables is made it should be noted that in the first test the room temperature was 26° C. and in the other 28° C. In the first test only one machine was used. The room temperature testing was completed before the 55° C. test was run, which resulted in a longer natural aging period before flexing for one group. Two machines were used in the second test, both hot and room temperature flexing being run at the same time. By changing machines during the course of the test the variation due to equipment was eliminated.

The effect of reducing the flexing temperature below normal has been observed *(4)* in our laboratory. Two samples of the tread stocks were flexed at 40° F. (4.4° C.) and at 80° F. (26.7° C.), on the U. S. Rubber Company type flexing machine per Method A, A.S.T.M. Designation D-430-35T. The stocks flexed at 40° F. cracked more rapidly than at 80° F.

Three British investigators *(5)* have shown that the internal frictional loss (a cause of fatigue) of rubber loaded with carbon black decreases with increases in temperature. They have also concluded that this frictional loss is an important factor in flex cracking. If this is correct it affords a very satisfactory explanation of the effect of temperature on flex resistance that has been observed.

Conclusions

Although limited to a conventional tread stock accelerated with mercaptobenzothiazole, we believe that a stock accelerated with mercaptobenzothiazole derivatives should behave similarly.

1. Excluding the accelerated aging effected by elevated temperatures, the flex cracking of vulcanized rubber proceeds more rapidly when flexed cold than when flexed hot.
2. Over-curing within the limits herein reported reduces the amount of cracking.
3. When flexed at elevated temperatures the flex cracks are fewer but larger than when tested at lower temperatures.
4. The effect of foreign material and surface irregularities is magnified by raising the temperature of testing.
5. The difference in the resistance of stocks to flex cracking is much more pronounced when tested at room temperature than at elevated temperatures. Normal temperature testing is, therefore, the more desirable for purposes of evaluation.

LITERATURE CITED

(1) Neal and Northam, *Ind. & Eng. Chem.*, **23**, 1449 (1931).
(2) Casie, Jones and Naunton, work unpublished.
(3) Crawford, *Ind. & Eng. Chem.*, **26**, 931 (1934).
(4) Neal, unpublished work.
(5) Casie, Jones and Naunton, *I. R. I. Trans.*, **12**, 49 (1936).

New Equipment

New Dust Counter

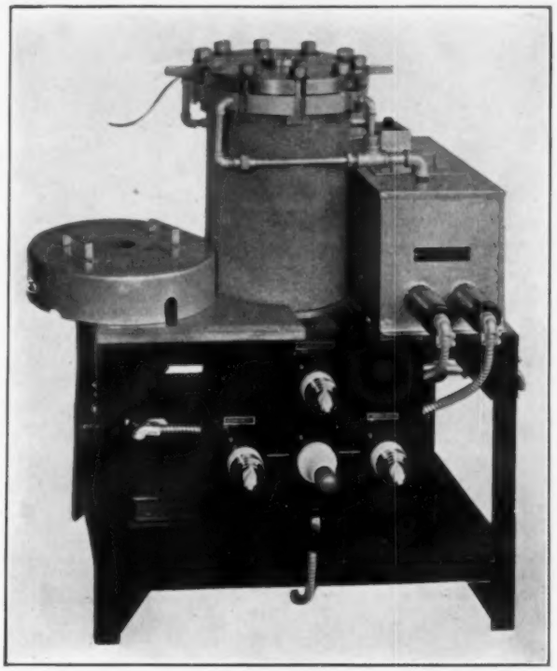
COMBINING scientific accuracy with ease in operation and simple procedure, the Bausch and Lomb Optical Company, Rochester, N. Y., has developed a new type of dust counter for measuring the dust concentration in all types of industrial plants. It combines in one unit both an air sampling device and a dark field microscope viewing and counting system, mounted on a circular base and provided with illuminating apparatus. The air sampling mechanism consists of a moistening chamber through which the air

Bausch and Lomb Dust Counter

is drawn by means of a calibrated hand pump of 1/1000 cubic foot capacity and an impinging device which deposits the dust particles suspended in the air on a circular glass plate within the instrument. The dust deposit is in the form of a ribbon and 12 samples may be collected on one slide. These samples may be viewed and counted at once without removal and may also be preserved for future reference by sealing a cover glass to the slide. The viewing and counting apparatus consists of a built-in compound microscope of 200X magnification. It is so calibrated that by multiplying the number of dust particles appearing in the square fields provided on the micrometer disc by 100,000 (simply adding 5 ciphers to the number) the total dust count per cubic foot is secured. The air moistening chamber is quickly cleared of any air left from previous sampling or exposure when new tests are desired by means of pressure on a rubber bulb.

Emerson Rubber Aging Apparatus

A NEW combination rubber aging apparatus, designed to use either oxygen or air, has been announced by the Emerson Apparatus Company, Melrose, Massachusetts. In addition to the oxygen and oven tests for aging, there had recently been proposed



Combination Rubber Aging Apparatus

in the rubber industry a new type of accelerated aging test using air under 80 pounds pressure and a temperature of 260° F. as an adjunct to the oxygen test. In some cases this air test was intended to substitute for the oxygen test because it required considerably less time for completion of the test and because it more nearly approximated actual operating conditions than the lower temperature test for rubber compounds of heat resisting requirements, such as inner tubes, steam hose, packing, etc. The Emerson combination Bierer-Davis oxygen and air aging apparatus, illustrated herewith, is designed to carry out either the oxygen test at 158° F. or the air test at 260° F. The bomb or receptacle carrying the samples under test is maintained at the required temperature by means of a circulating liquid jacket surrounding it. This liquid is heated in an adjacent reservoir and the temperature is controlled at that point. The liquid flows from the reservoir into a motor-driven pump from which it is forced up and through the jacket, overflowing from the jacket and thus repeating the cycle. The jacket is suitably lagged to prevent radiation and the unit is equipped with an insulated cover. The cover to the bomb is held in position by specially designed T head stud bolts which can quickly be removed by a slight loosening of the nuts.

Owners of Noble's "Latex in Industry"

The author has prepared an addenda and errata list which represents not only errors in patent numbers and typography but which includes a number of references originally omitted from the book. This list, in printed form which may be readily pasted into the original copy, is available without cost to all purchasers of the book. Address requests to THE RUBBER AGE, 250 West 57th Street, New York City.

Book Reviews

Chat. Binney and Smith Company, 41 East 42nd Street, New York City. 10 x 11½ in.

This is another in the series of "chats" issued by Binney and Smith, the last of which appeared several years ago. Formerly, the "chats" appeared in the form of 5x8 inch booklets, but the current volume appears in the form of a loose-leaf folder of standard size so that future bulletins may be properly filed for reference purposes. In the current issue, the company has correlated the data previously published in the form of bulletins and memoranda on Micronex. Its production, characteristics of each of the six types, recommendations for use and other information is given. A tabulation of grades and uses appears in the volume. Provision is made in the folder for filing subsequent data under the following heads: Carbon Blacks, Aqueous Dispersions, Mapico Colors, Parmr, Stearic Acid, Talc and Miscellaneous.

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U. S. Packings. United States Rubber Products, Inc., 1790 Broadway, New York City. 8½ x 11 in. 112 pp.

This manual has been prepared to insure the most efficient application of industrial packings to the specific purposes for which they were designed. One of the most complete manuals ever compiled on the subject, it gives engineering data indicating the various characteristics of each U. S. Packing, includes recommendation charts, and has a 12-page engineering section devoted exclusively to charts listing specific gravities, temperature of steam at different pressures, a Fahrenheit-Centigrade conversion table, metric conversion table, and other useful data.

•

Tag Laboratory Thermometers and Hydrometers. C. J. Tagliabue Mfg. Company, Park and Nostrand Avenues, Brooklyn, N. Y. 8½ x 11 in. 16 pp.

In addition to the regular line of precision and standard thermometers and hydrometers made by the company, this catalog includes complete listings of the widely-used A.S.T.M. Thermometers, as well as the TAG-A.P.I. and TAG certified hydrometers. Data includes comparison scale graduations, corrections for emergent stems, instructions for use, and Fahrenheit and Centigrade conversion tables.

•

Ace Laboratory Apparatus. Ace Glass, Incorporated, Vineland, N. J. 8½ x 11 in. 142 pp.

This catalog illustrates and describes the large assortment of glass laboratory apparatus manufactured under the Ace trade-mark, featuring interchangeable ground glass connections. These connections are fabricated by a special method and their advantages are pointed out in the catalog.

•

Alemite Controlled Lubrication. Alemite Division, Stewart-Warner Corporation, Chicago, Ill. 8½ x 11 in. 56 pp.

Printed in two colors, this catalog presents the entire range of Alemite's industrial equipment, such as hand guns, power-operated units, fittings, hose, valve meters, etc., and includes a section on hand gun repair parts. Many of the illustrations show the equipment in actual use in different types of industries.

•

Goodrich Almanac for Farm and Home—1937. B. F. Goodrich Company, Akron, Ohio. 5¼ x 8 in. 64 pp.

This almanac follows the time honored almanac pattern, with the exception that special emphasis is laid on the many uses of rubber on the farm, while features of special interest to farmers, such as the care of farm machinery, changeover from steel tractor wheels to rubber-tired wheels, an accurate load and inflation table for both tractor tires and farm implement tires, etc., are included.

Index to A. S. T. M. Standards and Tentative Standards. American Society for Testing Materials, 260 S. Broad Street, Philadelphia, Penna. 6 x 9 in. 120 pp.

Information on all of the 796 standards as of January 1, 1937, are given in this latest edition of the A. S. T. M. index. It is of service to anyone wishing to ascertain whether the Society has issued standard specifications, test methods, or definitions covering a particular engineering material or subject, and is of help in locating the standards in the volumes in which they appear. In addition to listing all items under keywords according to subject, the index also includes a list of specifications and tests in numeric sequence of their serial designations.

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Brown Flow Meters. Brown Instrument Company, Philadelphia, Penna. 8 x 10½ in. 56 pp.

The complete line of Brown flow meters—indicating, recording and integrating, in both electrical and mechanical types—is covered in this newest catalog (No. 2004), in addition to the Air-o-Line flow and liquid level controllers. Application of these instruments to power plant, water works and gas generation service is given, as well as their uses to general industry. The catalog is well illustrated and attractively printed in three colors.

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Glossary of Terms for Rubber Manufacturers. Stamford Rubber Supply Company, Stamford, Conn. 4½ x 7 in.

This is the second edition of the glossary of rubber terms, the first of which was issued by the company in 1935. The new edition contains many terms and definitions not previously included, while many of the original definitions have been simplified and clarified. The booklet also embodies the advantages to be gained by the use of factice in rubber manufacturing processes.

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The Story of Neoprene. E. I. du Pont de Nemours & Company, Ltd., Wilmington, Delaware. 8½ x 11 in.

Scientifically accurate, but told in non-technical language, this bulletin traces the discovery, commercial development and expansion of neoprene (formerly called DuPrene), and discusses its significance to science and industry. It includes a partial list of current applications in various fields and has a short chapter devoted to neoprene latex.

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1937 Year Book. The Tire and Rim Association, Inc., Guarantee Title Building, Cleveland, Ohio. 8¼ x 10¾ in. 86 pp. $2.00.

Latest rim specifications for all types of tires, from passenger car to miscellaneous uses, are included in this edition. In order to eliminate confusion in the industry resulting from the use of so many different types of valves, the Association has included an approved standard design for "Rubber Valves." Thirteen tire manufacturers are listed as Association members.

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You Bet Your Life! Travelers Insurance Company, Hartford, Conn. 6 x 9 in. 36 pp.

Reports of 36,800 fatalities and 967,840 injuries in traffic accidents during 1936 are analyzed in this booklet which bears the sub-title, "A Review of America's Shameful Automobile Accident Record." It is replete with statistical information and represents another in the series of booklets being issued by the company to combat the growing number of traffic accidents.

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Paterson and Its Industries. Industrial Commission, City Hall, Paterson, N. J. 4 x 9 in. 12 pp.

Advantages of Paterson as an industrial city, suitable for the location of various types of industries, is contained in this booklet, which also includes a statement of policy from the recently-organized Industrial Commission, the purpose of which is to attract new industries to the city and to strengthen the competitive position of its industries in outside markets so that they may expand and increase local employment.

Editorial Comment

Twentieth Birthday

ELSEWHERE in this issue mention is made of an important milestone in the history of The Rubber Age — celebration of its twentieth anniversary. Twenty years is not so long a period in the history of the rubber industry, but the past twenty years have witnessed many outstanding developments in rubber technology, developments which have resulted in the material becoming indispensable to mankind.

The list of single developments that contributed to this progress during the past two decades is long and the end is nowhere in sight. Right now we are making rubber history. For the moment latex holds the center of the stage, closely followed by synthetic rubber. The early future will probably see the price of synthetic rubber brought within the range of fluctuating crude rubber prices, with that branch of the industry assuming the role of the star performer. In turn, some other development will be born, nurtured and reach maturity. A new material? A new method? *Quien sabe!*

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Elimination of a Trade "Evil"

ONCE again tire manufacturers, backed by the mass distributors, have taken a forward step to put that branch of the rubber industry on a firm footing. They have dropped the costly guarantee known as the "road tire hazard" warranty, which permitted purchasers to return any tire which had a visible "injury" and receive a credit based on months of service rendered to apply against the purchase of a new tire. It is estimated that this warranty cost the industry no less than $10,000,000 annually. It was originally introduced by the Standard Oil companies when they entered the market with the Atlas tire line, and gradually assumed the role of a Frankenstein.

Two or three years back when Hugh Johnson was organizing the ill-fated N.R.A. (which may shortly again be in our midst), the Government took cognizance of the road hazard warranty and in an emergency order stipulated that a 90-day warranty be the standard of the industry. This order met with considerable favor from the larger tire manufacturers, but protests poured into Washington from the small manufacturers and the mass distributors. Subsequent delays of a hearing on the topic relegated it to oblivion —the demise of the N.R.A. preceding a finally scheduled hearing.

Although the history of the introduction of the "road tire hazard" warranty is interesting, it is not one whit as important as its elimination in favor of the standard R.M.A. tire warranty—which covers the life of a tire on workmanship and materials. More important is the fact that again the tire manufacturers have joined forces to eradicate an "unnecessary evil." If the price situation remains unmolested by disturbing interests the elimination of the road warranty should be reflected in the profits of every tire manufacturer next year.

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Introduction of Rayon Tires

FROM time to time word has reached the rubber industry of the progress recorded in experiments with rayon as a substitute for cotton in the manufacture of tires. Both the several tire manufacturers and the rayon interests have been most secretive about these experiments. Specific investigations with regard to its progress, conducted by this journal and other publishing organizations, brought to light only general statements and the barest of details. THE RUBBER AGE has probably published more comprehensive material on the early development stages than has any other source.

Now, both U. S. Rubber and Goodyear have announced tires made with rayon. It is inevitable that other manufacturers will shortly announce similar tires. It is known, for instance, that Firestone has been conducting experiments along these lines for five years or more. Use of rayon, however, as a substitute for cotton is at present confined only to bus and truck tires. In other words, where high speeds and excessive loads are a factor, tires made with rayon are expected to give better performance. P. W. Litchfield, president of Goodyear, makes the statement that such bus and truck tires will give four to five times the mileage of tires made with cotton. In passenger car types, rayon cord tires will equal but will not surpass standard tires, it is stated.

Introduction of the first rayon cord bus and truck tires may be the forerunner of a complete new line of tires for all purposes. We are inclined to agree with Dr. S. M. Cadwell, director of tire development, U. S. Rubber Products, Inc., that "the part rayon will play in influencing future tire performance should not be underestimated."

CURRENT • NEWS of the Rubber Industry

MARCH, 1937

TRADE INTRODUCES RAYON CORD TIRES

Goodyear and U. S. Rubber Announce New Type of Tire for Truck and Bus Use, Claiming Four to Five Times More Mileage

Both the Goodyear Tire and Rubber Company and U. S. Rubber Products, Inc., have announced the introduction of tires made with rayon cord for truck and bus service. Other tire manufacturers are expected to make similar announcements in the next few weeks, according to report. Introduction of these tires culminates an experimental period of more than ten years.

One of the most difficult problems of modern bus and truck transportation, according to P. W. Litchfield, Goodyear president, involves both safety and costs in respect to high speed runs with heavy loads. For these operations, he states, experiments have demonstrated that tires made of rayon cord may be expected to give, in most cases, four to five times as much mileage as other tires. Where speed is not excessive and moderate loads are carried, however, as in normal passenger car use, rayon tires will not surpass the performance of standard tires.

Litchfield Discusses Development

Mr. Litchfield's statement follows: "Goodyear's Development Department began its experiments with rayon tires as early as 1927. Its purpose was to create a tire capable both of resisting and throwing off the destructive internal heat in a tire that is set up at sustained high speeds under heavy loads . . . In order to solve the twin problems of friction and heat, a new material was developed with a cellulose base for spinning yarn, and then a way was devised to work this yarn into tough, strong cords—rayotwist—to serve as the base of the tire.

"Since exhaustive tests have indicated that rayotwist retains its tensile strength under the most adverse conditions, its use in heavy-duty truck and bus tires for modern high-speed transportation is expected to result in longer tire life and much lower mileage costs for such tire service."

In the U.S. Rubber Products' statement, many of these claims were duplicated. It said, in part, "The new carcass material retains a greater portion of its strength than cotton at the scorching temperatures of high-speed, heavy-load tire operations . . . as a result, the new U.S. Royal has remarkable carcass strength that adds measurably to tire life." More than 100,000,000 test miles were run in developing the rayon cord tire, according to the statement.

Cadwell Issues Statement

In discussing the future of the new rayon material, Dr. Sidney M. Cadwell, director of U.S. tire development, stated: "The part rayon will play in influencing future tire performance should not be under-estimated. As the search for new and better tires goes on the U. S. tire engineer is in a particularly strategic position to take advantage of future developments. For behind him are millions of test miles with rayon and a century's development of successful experience with rubber."

Future developments regarding these new rayon cord tires, as well as a more comprehensive review of its development, will appear in an early issue of this journal.

Average Tire Bill

According to a survey by the B. F. Goodrich Company, Akron, the average American motorist's tire bill will be about $15 during 1937, or less than 8% of his expenditures for tires 30 years ago. In 1907 at least 5 new tires were required annually to keep a car in running order, and the average mileage was approximately 3,000 miles. Due to improvements in tire construction, the owner of a modern automobile needs only 1.3 tires annually.

Goodrich Sponsors Contest

A national letter writing contest for American farmers on "Why I Should Like to Have Rubber Tires on My Tractor and Farm Implements" has been announced by the B. F. Goodrich Company, Akron. The contest, which provides $3,000 in cash awards, including a first prize of $1,000, closes on March 31st, and all entries will be scanned by a competent board of judges.

INDUSTRY MODIFIES TIRE GUARANTEES

Manufacturers and Distributors Join Forces in Dropping Costly Guarantee in Favor of Warranty on Both Workmanship and Materials

Effective on February 25th, tire manufacturers discarded the costly and unwarranted "road hazard" guarantee and substituted the standard warranty of the Rubber Manufacturers' Association. Whereas the former permitted a customer to turn in a tire injured by a stone bruise or other evident casualty and receive in trade on a new tire a credit based on months of service rendered by the "injured" tire, the standard warranty covers the life of the tire from the standpoint of defective workmanship or materials.

The "road hazard" guarantee came into existence several years ago when it was adopted by the Standard Oil companies as an entering wedge into the field. Naturally proving popular with the ultimate consumer, it was not long before the guarantee was adopted by practically every tire manufacturer, not by preference, but of necessity to protect his dealers. The effect of the guarantee is said to have cost the tire industry approximately $10,000,000 last year.

Mass Distributors Agreeable

Not only the manufacturers, but most of the mass distributors have adopted the standard warranty, which is essentially the same as that proposed by the short-lived Rubber Institute, Inc., in 1928. Sears, Roebuck and Company, Montgomery-Ward, and others have already discarded the "road hazard" guarantee. The policy of Standard Oil on its Atlas tires, however, has not yet been made known.

So serious did the guarantee situation become at one time, that during the early days of the NRA code an emergency order was issued covering retail tire sales which stipulated that a 90-day warranty be the standard of the industry. Because of the protest made by a few small tire manufacturers, most of the mass distributors and the gas station interests, a stay of thirty days was granted on this order with subsequent indefinite stays.

PROGRESS REPORTED BY COMMITTEE D-11

In reviewing its activities during the past year, Committee D-11 on Rubber Products of the American Society of Testing Materials reports that several recommendations of the Committee were approved, including the adoption as standard of three test methods covering rubber belting (D 378), braided hose (D 379) and wrapped rubber hose (D 380), in addition to important revisions in eight tentative standards.

Much progress was made in the development of ways and means by which standard abrasion specimens having certified properties for use as a reference base in test methods could be made available. Eleven laboratories are cooperating to determine whether satisfactory uniformity and duplicability of standards can be maintained. The Committee reports that results have been encouraging. A similar study will pertain to tensile strength specimens.

Because of the importance of the air bomb aging test in determining effect of air at elevated pressures and temperatures on compounds, this being used in various forms by 18 of 22 laboratories surveyed, a standardized procedure is being prepared.

New methods of chemical analysis for determining sulfur, copper and manganese, the latter by the ammonium persulfate method, are being studied. Also under way is work involving reclaimed rubber and latex.

Other problems being investigated by Committee D-11 concern tests for physical changes of rubber and rubber-like products after immersion in solvents, testing adhesion under shearing stresses and coordination of physical test methods issued by various organizations.

GENERAL TIRE OPENS ITS WABASH PLANT

Production was initiated on March 1st in the new mechanical goods plant of the General Tire and Rubber Company at Wabash, Indiana. Lawn-mower tires, rubber acid containers and electric refrigerator fittings are some of the mechanical goods currently being produced. Remodeling of the plant and installation of new equipment has been under way for the past several months. Installation of a water supply system to furnish 3,000,000 gallons of water daily, which the plant will require when in full operation, was one of the major improvements completed.

Total floor space at the Wabash factory comprises 200,000 square feet. It is situated on a site covering 30 acres of ground, and was formerly occupied by the Service Motor Truck Company. According to present plans, tires will not be manufactured, only a wide variety of mechanical rubber goods. Howard M. Dodge is general manager of the new plant, assisted by William O'Neil, Jr., eldest son of General Tire's president.

In America, General Tire's only tire manufacturing operations are confined to Akron, while in Mexico City, the Companhia Hulera el Popo, an associated compani, produces General Popo tires, and in Canada, General tires are manufactured by the General Tire Company of Canada, Ltd. The company also has a working agreement with the firm of Stomil, Ltd., in Poznan, Poland, for the manufacture of tires according to General's specifications.

Atlas Acquires Revolite

The Atlas Powder Company, Wilmington, Delaware, has acquired all rights to Revolite, the fabric material coated with a Bakelite resinoid, previously manufactured by the Revolite Corporation, a Johnson and Johnson subsidiary. The manufacture of Revolite will be continued at Stamford, Conn., by the Zapon Division of the Atlas concern. The acquisition embraced both sales and manufacturing personnel.

Move Imperial Offices

The Imperial Oil and Gas Products Company, Pittsburgh, has announced the removal of its general offices to the 12th floor of the Grant Building, as of March 1st. Offices were previously maintained in the Union Bank Building. The telephone numbers are Court 2647 and 2648.

DAYTON BUYS BALANCE OF McCLAREN COMPANY

Purchase of the plant and remaining equipment of the former McClaren Rubber Company, at Charlotte, North Carolina, has been announced by the Dayton Rubber Manufacturing Company, Dayton, Ohio. About a year ago, Dayton bought the name and most of the McClaren equipment, moving it to its Dayton plant. Since that time, McClaren tires have been sold through a special McClaren Division of the Dayton Rubber Manufacturing Company. The purchase also included acquisition of the McClaren sales branch in Charlotte.

Although A. L. Freedlander, president and general manager of Dayton Rubber, would not make public the amount of money involved in the new transaction it is believed to represent a sizeable sum, since the old McClaren plant employed 450 people at normal operation and had an annual payroll of more than $500,000. His statement, however, in connection with the purchase, indicated that the Dayton concern will start manufacturing operations in the McClaren plant in the near future, with the McClaren tire production probably being returned to its former plant. The McClaren branch, and the Dayton district sales offices, are being removed to the Charlotte factory. P. W. Horn will be in charge.

RSL TECHNICAL STAFF FETES SALES DIVISION

The technical staff of the Nitro, West Virginia, plant of the Rubber Service Laboratories Division, Monsanto Chemical Company, during a recent two-day conference of the sales and compounding division, feted the sales division of the company. This meeting was held at Nitro, although as a rule they are held at the Akron sales offices. The affair took place in the Banquet Room of the Daniel Boone Hotel in Charleston. E. J. Smail, Jr., general sales manager of RSL, may be seen at the head of the first table in the foreground.

CLAIM 30-HOUR WEEK WOULD HURT BUSINESS

According to a statement recently made by the B. F. Goodrich Company, Akron, the company's opportunity to compete for business would be seriously affected if all of its employees were restricted to a 30-hour week, and if it attempted to pay wages under this condition in keeping with the average annual earnings paid during 1936. The statement points out that last year employees in the Akron plants of Goodrich worked an average of 32.8 hours per week, with continuous operations based on a six-hour shift, but with a flexible six to eight-hour day for operations that were not continuous. The average for all industry during 1936 ranged from 38 to 42 hours.

In a supplementary statement from a company spokesman, the point was made that "during 1936 no employee worked more than 40 hours in any one week except upon approval of the general superintendent of the division in which the worker was employed, or an executive officer of the company." If the working day is limited to six hours, the average hours during 1937 will drop below 30 hours a week, it was stressed.

"Under such conditions," the statement reads, "to maintain for our employees average annual earnings comparable to those paid in 1936 which were one-third more than the average of all industry, it would be necessary for our Akron factories to pay an hourly wage two-thirds more than the average hourly wage for all industry. Such an hourly wage would limit our opportunity to compete for business."

Goodrich particularly stressed the point that flexibility in hours per day and per week is essential "if maximum annual earnings are to be enjoyed by the average employee."

USES OF NEOPRENE OUTLINED BY DUPONT

In a special bulletin to the trade, E. I. du Pont de Nemours and Company, Inc., Wilmington, Delaware, listed some of the recent applications to which neoprene (formerly DuPrene has been adapted. The list included the following:

As a lining for hose to convey gasoline, oils, gases, solvents and chemicals of all kinds; gaskets and packings where oil and heat would normally make rubber gaskets unsuitable; for the manufacture of printers' rollers; printing plates; as jackets for the protection of electrical wires; balloon fabrics to hold hydrogen and helium gas; covering for conveyor and power belting; refrigerator seals; gloves for use in the chemical industries; diaphragms; hospital sheeting; tank linings; sealing strips; etc.

The bulletin also devoted some space to neoprene latex, said to have a marked resemblance to natural latex with the distinction that its particles are much smaller. Neoprene latex is made by polymerizing an emulsion of chloroprene in water, according to the bulletin, which concludes with the statement that the price of neoprene depends upon the quantity sold plus the skill of laboratory workers in still further simplifying the process of manufacture.

Issue Import Statistics

As part of a W.P.A. project, the United States Tariff Commission, Washington, D. C., has just released a compilation of rubber import statistics for the calendar years of 1931 to 1935, inclusive, in booklet form. This is said to be the first time that figures for the earlier years (1931, 1932, 1933) have been made available showing imports for consumption—both entries for immediate consumption and withdrawals from bonded warehouses for consumption—by countries from which the imports originated. Heretofore, it is reported, statistics of imports by countries have been on the basis of general imports, which include all entries into the United States, whether for immediate consumption, warehousing or reexport. Except where otherwise noted in the booklet, the value of imports is the foreign wholesale value converted to United States currency at the rate of exchange prevailing when the merchandise was shipped to this country.

New Plant for National

According to published reports, the National Tire and Rubber Corporation, East Palestine, Ohio, will shortly erect a tire plant in Elizabethton, Tennessee. The East Palestine factory, which will be maintained as general offices, will manufacture first grade tires only, in addition to camelback, cushion and repair materials, rubber cement and retreaded tires, while all grades and sizes of tires, including private brands, will be produced at the Tennessee factory. It is understood that the new plant will comprise three one-story units, each approximately 55 x 300 feet, a steam power house and office buildings. Total cost of putting the plant into operation is estimated at $235,000.

To Broadcast on Rubber

A program devoted to rubber in all of its many phases will be broadcast by Harry R. Daniel of the Department of Commerce on March 20th over the Columbia Broadcasting System in a nation-wide hook-up. This program is one of a series sponsored by the Department of Commerce on "Great American Industries", the idea behind each program being the presentation of a human interest story of the origin, development and record of achievement of the large American industries. The programs are broadcast from New York City.

Trenton News

Filatex Corporation, which recently moved its manufacturing activities from Northampton, Penna., to Trenton, has awarded a contract for a one-story brick factory. The concern was recently incorporated at Trenton with 4,000 shares of capital stock at $100 a share and 200 shares of no-par common. Incorporators included George S. Hills, Harriet Taylor and Herbert C. Simpson, all of New York City. Filatex has leased the former plant of the Bel'e Mead Sweets Company.

Morrison Rubber and Packing Company, specializing in semi-metallic packings, has removed from Philadelphia to Trenton where it has opened an office and warehouse on Canal Street. Thomas Morrison, Jr., is president and R. A. Heath, secretary-treasurer.

A two-story frame warehouse of the Thermoid Company, Trenton, containing baled rubber, frictioned fabric, paints and other supplies, was completely gutted by fire on February 17. Loss was estimated at several thousand dollars. Firemen fought the blaze for three hours and were successful in preventing its spreading to adjoining buildings, many of which contained valuable stocks of additional raw materials. William H. Hall, Jr., general works manager, stated that the structure would be replaced.

It is rumored that the factory of the Dural Rubber Company, at Flemington, N. J., which was closed down some time ago, will be re-opened in the immediate future as an automobile tire plant. Dural had been in operation for many years prior to the shut-down.

The Rubber Specialty Company, Conshohocken, Penna., was one of the few concerns in the New Jersey-Pennsylvania area forced to shut-down recently because of the General Motors strike.

Trenton rubber plants are still busy on orders for suction hose for many cities in the South and middle-West affected by the recent floods. Those engaged in producing automotive rubber goods are rushed with orders to catch up on the lag caused by the automobile labor difficulties.

Thermoid Rubber Company, Trenton, has asked the Mercer County Freeholders to build a detour so that heavy traffic will not interfere with operations at its plants located on either side of Whitehead Road.

HOLT TALKS BEFORE BOSTON RUBBER GROUP

E. G. Holt, assistant chief, Leather and Rubber Division, was the principal speaker at the mid-Winter meeting of the Boston Group, Rubber Division, A.C.S., held in the Hotel Kenmore, Boston, Mass., on February 12th, which was attended by 106 members and guests. The second speaker of the evening was H. E. Grier, research assistant, Photographic Laboratory, Massachusetts Institute of Technology.

Selecting as his subject "Rubber Prices and the Price of Rubber," Mr. Holt thoroughly covered the ground, pointing out that the average price of prime ribbed smoked sheets in New York was 11.9 cents in 1930, 6.1 cents in 1931, 3.4 cents in 1932, 5.9 cents in 1933, 12.9 cents in 1934, and 12.3 cents in 1935, but that throughout this period of low prices the plantation rubber industry lived through it successfully, suffering the hardships experienced by all agricultural industries, but as a result introducing numerous economies that reduced costs to levels previously regarded as impossible.

The speaker emphasized the point that although in 1930 the producing industry costs were barely reduced to the average sales price of rubber for that year (11.9 cents), in 1934 and 1935, when a lower average price was maintained, the industry was again earning profits, most British companies actually paying between 3½ and 4% dividends in 1935. This is particularly important in view of the fact that permissible exports averaged only 67.5% of basic quotas in that year, he stated.

Warns Against Immoderation

From these remarks, Mr. Holt drew the conclusion that a price range of 14 to 17 cents is reasonably justifiable under recent producing conditions, although higher taxation on plantations might raise this range another cent, while a steady price above 20 cents would assure very high profits for all efficient plantations. He warned producing interests that the history of past rubber restriction measures gives some basis for believing that any immoderation starts economic trends that finally injure those trying to achieve too great benefits for themselves. Confidence in the aims of the administration of the present scheme has been shaken by the recent trend in prices and declining stocks, he stated, but it has not been destroyed and it may be rebuilt.

Concluding his discussion, Mr. Holt said: "The record clearly shows that during the past three months world stocks of rubber were too low to prevent speculation to a very undesirable extent . . . It is to be hoped that restriction will be so administered as to restore stocks to the level necessary for more stable prices at a reasonable level. The lesson seems to be that stocks ought never to be so reduced by an intergovernmental body as to place speculative interests in control of this commodity."

Mr. Grier, who substituted for R. M. Horn, the scheduled speaker, delivered an address on "Seeing the Unseen," accompanying his talk with motion pictures showing exactly what has been accomplished in studying rotating motion with the aid of the Edgerton Stroboscope.

Coming Events

March 15-17. Annual Convention, N.A.W.M.D., Hotel Sherman, Chicago. (Including Scrap Rubber Institute meetings).

March 19. Akron Group, Rubber Division, A.C.S. Akron City Club, Akron.

March 26. Chicago Group, Rubber Division, A.C.S., Sherman Hotel, Chicago.

April 2. New York Group, Rubber Division, A.C.S., Building Trades Club, New York.

April 6. Los Angeles Group, Rubber Division, A.C.S., Mayfair Hotel, Los Angeles, California.

April 14-15. Rubber Division A.C.S. Chapel Hill, North Carolina.

April 14-15. Eastern Mid-Year Conference, Rubber Section, National Safety Council. Hotel Astor, New York City.

June 28-July 2. Annual Meeting, A.S.T.M. Hotel Waldorf-Astoria, New York City.

September 13-17. Rubber Division, A.C.S. Rochester, N. Y.

October 11-15. National Safety Council. (26th Safety Congress). Kansas City, Mo.

Dec. 5-11. Exposition of Chemical Industries, Grand Central Palace, New York City.

N. Y. Group Meets April 2

The New York Group, Rubber Division, A.C.S., will hold its next meeting on Friday evening, April 2nd, at the Building Trades Club, 2 Park Avenue, New York City. Dr. E. A. Hauser, internationally known rubber technologist, and associate professor of the Massachusetts Institute of Technology, will deliver an address on "Colloidal Materials." It is understood that Dr. Hauser will reveal some of the results of recent experiments at the M.I.T. laboratories and an interesting talk is expected. In addition to this speaker, the committee is making arrangements for a program of entertainment. As usual, tickets are $2.00 each, which includes the dinner. Tickets may be secured from and reservations made with B. Brittain Wilson, c/o *India Rubber World*, 420 Lexington Avenue, New York City, secretary-treasurer of the group.

LOS ANGELES GROUP HOLDS MARCH MEETING

That interest remains keen in the monthly meetings of the Los Angeles Group, Rubber Division, A.C.S., was evident at the gathering held on Tuesday, March 2, in the Rainbow Room of the Mayfair Hotel, when practically every chair at every table was filled. It was pointed out by Chairman T. Kirk Hill that the membership today is practically five times what it was two years ago. At the beginning of 1935 there were 33 members; in January, 1936, there were 106 members; and in March 1937, there are 163 members.

The program for the March meeting featured variety. W. R. Cisney, assistant sales manager for A. Schrader's Sons, in Los Angeles on a visit from the East, spoke briefly on tire valves, emphasizing the point that the original principle involved in the first valve for a bicycle tire made more than 40 years ago by Schrader is still the principle used.

Blair Woolstencroft, a Glendale resident, gave a reading entitled "A Newsboy's Soliloquy". E. L. Wright, of the technical division of the Thiokol Corporation, Yardville, N. J., spoke briefly on the development of the different products of his company and answered a series of questions. A motion picture, "Building the West", was presented by George Buccola through the courtesy of Associated American Distributors, Inc. The film dramatized the great natural resources of the west, particularly California, and showed graphically the development of business and industry there.

The main address of the program was inspirational rather than technical and was given by Rev. J. Whitcomb Brougher, Jr., pastor of the First Baptist Church at Glendale, California. The subject was, "Looking Ahead", and the talk embraced a well balanced combination of humor and philosophy. The speaker complimented the personnel of the rubber industry on its fixed habit of looking ahead as evidenced in the phenomenal developments in the industry in such a comparatively short span of time.

Golf Tournament Planned

Dick Newell, chairman of the golf committee, announced the completion of plans for a golf tournament on the second Saturday in March (March 13), beginning at 1:30 P.M. Golf tournaments are always popular in the group and well patronized.

Door prizes were donated by Martin Breuer of E. I. du Pont de Nemours and Company. First, second and third prizes were won by William Barworth, B. E. Dougherty and Carl E. Stentz, respectively. A special prize, a pair of field glasses in a leather case, donated by A. L. Pickard of the Braun Chemical Corporation, was won by W. D. Schwartz of the L. H. Butcher Company. Small bottles of perfume were presented to all as table favors by the Medford Chemical Company.

The April meeting will be held in the same place on April 6.

NEW ENGLAND NEWS

A number of labor bills, which if enacted would affect rubber manufacturers, are being considered by the Connecticut General Assembly at Hartford. Most of these are of a general nature, stipulating maximum hours, etc. One measure sets a 40-hour work week, with an eight-hour day, for both men and women; another provides only for a 40-hour week; and a third limits hours for women to 48 hours in six days, with a provision that 10 hours may be worked in one day.

Senate Bill 64 would include "calender rolls in rubber manufacturing" among types of machinery which children under 18 would be forbidden to operate. Another bill of interest to rubber manufacturers is House Bill 721, providing that in lieu of the local tax on factory machinery, municipalities would receive receipts from the state corporation tax in excess of $1,500,000. Connecticut manufacturers would gain about $2,000,000 if this measure became law, but its passage is considered doubtful.

Viscol Company, a subsidiary of the Stamford Rubber Supply Company, Stamford, Conn., has been incorporated in that city with authorized capitalization of $50,000, of which $15,000 has been paid in. Its stated purposes are "to make and deal in products compounded mainly from vegetable, animal or mineral oils, etc." Richard H. Gillespie is president; Kingsley Gillespie, vice-president; and William F. Gillespie, secretary and treasurer. Each holds one share, while the Stamford Rubber Supply Company holds the remaining 147 issued shares.

Elgie D. Lombard, for many years Western Massachusetts representative of the Hewitt Rubber Company, Buffalo, N. Y., with an office in Holyoke, died February 13 at his home in Springfield, Mass.

Goodyear Rubber Company, Middletown, Conn., specializing in the manufacture of rubber boots and arctics, ceased operations temporarily on February 15. Weather conditions, resulting in a drop in demand for the company's products, necessitated the suspension, according to Arthur McDowell, executive. About 500 employees were laid off.

Middletown Rubber Company, Middletown, Conn., is expanding operations and because of increased volume of business has increased its capital from $50,000 to $100,000. The plant is now operating, during a seasonal lull, with one shift for 125 employees. Nearly 40 hands have been added during the past year.

After a shutdown of two months for overhauling of machinery, the Paragon Rubber Corporation and American Character Doll Company, affiliated concerns in Easthampton, Mass., are resuming production, according to Edward G. Schaeffer, president of both companies. Lack of proper care in installing equipment when the plant was first opened last year resulted in frequent breakdowns, necessitating the recent repairs, Mr. Schaeffer said.

A. J. Donahue Corporation, Milford, Conn., manufacturer of garters, has let contracts for construction of a machine shop on Factory Lane, to cost about $2,000. The building will be 46 x 26 feet, of frame construction.

Shipments of crude rubber from New York to New London, Conn., for storage in the warehouse on the state pier, were halted during mid-February by a labor dispute. Longshoremen at the state pier demanded an increase in wages.

Plan Chemical Exposition

Three floors in the Grand Central Palace, New York City, have been reserved for the Sixteenth Exposition of Chemical Industries, which will be held on December 6 to 11 this year. Advance leasing to date indicates that the 1937 Exposition will be one of the largest in recent years, according to Charles F. Roth, who again is in personal charge. A feature of this year's show will be a prize competition for a slogan typifying the role of chemical industries in modern life. This slogan is expected to represent accurately the purposes of the chemical industries and the benefits accruing to mankind from their activities.

Rubber Companies Raise Wages

Following the lead set by Goodyear, Goodrich, Firestone and General, rubber companies throughout the United States have granted wage increases to both factory and office workers. The pay increases announced by the "big four" of Akron, ranged from 5 to 8 cents an hour for factory workers, and will increase the annual pay roll of the city by approximately $3,000,000. Other companies to announce increases included Kelly-Springfield, Ohio Rubber, Chardon Rubber, the West Coast factories of Goodyear, Goodrich and Firestone, and others.

"Good Aging" Folder

The General Atlas Carbon Company, New York City, recently mailed a folder entitled "Good Aging" to its friends and customers. This is one of a series prepared and distributed by the company. The current folder, as the title indicates, is devoted to aging characteristics, and contains a table summarizing a typical comparison between Gastex and another black.

RUBBER CONSUMPTION DROPS 1.8% IN JANUARY

Consumption of crude rubber by manufacturers in the United States for the month of January is estimated to be 48,744 long tons, which compares with 49,626 long tons for December. January consumption shows a decrease of 1.8% under December and is less than 1% above January a year ago, according to statistics released by the Rubber Manufacturers Association. Consumption for January, 1936, was 48,506 (revised) long tons.

Imports of crude rubber for January are reported to be 32,820 long tons, a decrease of 42.5% under the December figure of 57,049 long tons, but 4.9% over the 31,292 long tons imported in January, 1936.

Total domestic stocks of crude rubber on hand on January 31 are estimated at 201,915 long tons, which compares with December 31 stocks of 218,844 long tons and 285,054 (revised) long tons on hand January 31, 1936.

Crude rubber afloat to U. S. ports as of January 31 is estimated to be 55,096 long tons which compares with 56,567 long tons afloat on December 31 and 43,870 long tons afloat on January 31 a year ago.

January reclaimed rubber consumption is estimated at 13,366 long tons; production, 15,129 long tons; and stocks on hand January 31, 31,610 long tons.

Safetex Moving Plant

Sometime in April, the Safetex Company, Inc., now located in New York City, expects to move its plant and offices to East Port Chester, Connecticut, just across the White Plains (New York) line. The company was recently incorporated in Connecticut, with $100,000 of authorized capital, $20,000 of which has been paid in. Incorporators included Raymond Healy, White Plains, N. Y.; Claude H. Daniels, Wellesley Hills, Mass.; and Alvah G. Sleeper, Somerville, Mass. The company specializes in latex dipped goods.

Jersey Rubber Washing Busy

The Jersey Rubber Washing Company, 36 Hudson Street, Jersey City, N. J., reports considerable activity at its plant. This company, which has been in business for more than 10 years, washes rubber and gums of all kinds. The Jersey City plant has a capacity for washing 5 tons of rubber daily, and sufficient room to hang 50 tons of rubber or more.

Pharis Insures Employees

A cooperative group policy insuring its 900 employees from $500 up to and including $2,000, according to wages paid, has been taken out by the Pharis Tire and Rubber Company, Newark, Ohio. The group insurance plan also includes sick and injury benefits from $7.00 to $20.00 per week.

CAPITAL UNDERPAID, SAYS F. A. SEIBERLING

"Rubber industry labor talks about being underpaid. What about capital? Capital is 'underpaid' now and has been for years." This statement was made by F. A. Seiberling, president, Seiberling Rubber Company, recently, on the occasion of his returning to the Seiberling offices after a brief rest.

Although he predicted that unit tire sales this year will reach record proportions and that replacement sales will be especially heavy, he stated that "manufacturers will not make the money they should unless prices go up." In this connection, he pointed out that "most manufacturers made a good showing last year compared to the depression years, but 5 or 6 per cent net profit is not enough for a tire manufacturer."

Continuing along these lines, Mr. Seiberling claimed that the tire business is so uncertain and has such wide fluctuations in manufacturing costs that "a 10 per cent net profit is needed if stockholders are to be paid and a cushion provided against the lean periods of business." In the case of the Seiberling concern, he stated, that "Seiberling showed a profit on last year's business, but before our directors received the statement we had pledged the profit back to the business in increased wages the first of the year."

Expressing optimism as to the future of his company, the veteran tire manufacturer chided the union faction of rubber labor with the statement that, "Capital won't move and credit won't loosen up when business men can't plan their affairs more than thirty days ahead."

INCREASE RECORDED IN RUBBER RE-EXPORTS

That rubber manufacturing activities are constantly being increased in many countries as well as being initially instituted in others, is indicated by the re-export statistics of the United States which reveal a steady trade in rubber shipments from this country to Latin American countries. Re-exports to Canada have declined, however, as a result of direct shipments from the Far East to the Dominion, that country falling to second place in 1936 for the first time in recent history as a market for re-exports from this country.

First place as a market for these re-exports in 1936 was taken by Italy, which turned to the United States during the period of embargo on rubber shipments to Italy from customary European and Eastern sources. Shipments to Germany also show a steady increase since 1932, despite the extravagant claims made by that country on synthetic rubber production and use.

Particular expansion, however, has been noted in the Latin American countries. Cuba, Mexico, Argentina, Chile and Uruguay are already buying regularly from the United States. Small shipments to several Latin American countries from which we import wild rubber, Peru especially, are also recorded for 1936. This is not so difficult to realize when it is considered that in terms of transportation the wild rubber regions of Peru are more remote from the Peruvian West Coast than is San Francisco.

According to the Leather and Rubber Division, re-exports from the United States in 1936 went to 23 foreign countries, which compares with re-exports to only 12 countries in 1934.

New Factory in Africa

A mechanical rubber goods factory at Benoni, in the Transvaal, South Africa, is planned by the British and Union Rubber Manufacturing Company (Pty.), Ltd., a new organization recently formed by the British Tyre and Rubber Company, Ltd., and J. H. Vivian and Company, Ltd., both of London, England. The products of the new company will be trade-marked "Burmco." Control of the organization rests with the British tire concern, according to report. All types of hose and rubber-to-metal products are planned for early production. A suitable factory site has already been selected and construction was expected to begin shortly.

18.5% GAIN RECORDED IN TIRE SHIPMENTS

Shipments of pneumatic casings during the month of December are estimated at 5,015,872 units, an increase of 18.5% over November and 22.9% above shipments made in December, 1935, according to statistics released by the Rubber Manufacturers Association.

Production of pneumatic casings for December is estimated at 5,311,007 casings, an increase of 6.8% above November and 31.1% above December, 1935.

Pneumatic casings in the hands of manufacturers on December 31, 1936, are estimated at 11,114,399 units, an increase of 2.7% over the stocks on hand November 30, and 35.6% above stocks on hand December 31, 1935.

The actual figures are as follows:

PNEUMATIC CASINGS

	Shipments	*Production*	*Inventory*
Dec., 1936	5,015,872	5,311,007	11,114,399
Nov., 1936	4,232,867	4,971,838	10,822,602
Dec., 1935	4,081,153	4,051,286	8,195,863
Dec., 1934	3,108,552	3,778,418	9,454,985

For the year ended December, 1936, total production of pneumatic casings amounted to 58,116,349 units, which compares with 49,361,781 in 1935 and 47,232,748 in 1934. Total shipments reached 55,362,739, which compares with 50,183,129 and 46,686,545, for 1935 and 1934, respectively.

BRIDGWATER MACHINE OCCUPIES NEW PLANT

Interior view of the new Bridgwater Machine plant in Akron

The Bridgwater Machine Company, Akron, manufacturer of rubber equipment, has abandoned its old plant and offices and has moved into a new and enlarged plant diagonally across from its former site and occupied by the Williams Foundry and Machine Company up to several years ago. This new location, peculiarly, is the original site of the Bridgwater plant when the company was founded 35 years ago. It has been completely modernized and provides more than 30,000 square feet of floor space. General offices are located in a separate building, connecting with the plant. Adequate crane and handling facilities, plus the addition of new equipment, has made it possible for the company to handle a steadily increasing amount of business, according to B. E. Bridgwater, not only on tire molds, trimming machines and other equipment for the rubber industry, but also on special job and production machining for various industries.

Akron Briefs

S. S. Miller, founder of the Mohawk Rubber Company and chairman of the board of directors, was presented with a radio for his office on the occasion of his eighty-first birthday, February 7, by admiring employees of the Mohawk company. Friends celebrated his four score and one years with a dinner at the Akron Liedertafel. Mr. Miller is still active in the business of manufacturing tires and is still an acknowledged authority on tire design. He is at his desk in his office every day, always the first to be on the job in the morning. A keen analyst of the tire market, he believes that another advance in the price of tires is inevitable and believes that the sooner the advance is made the quicker the market will be stabilized.

Officials of the Sun Rubber Company have confirmed the report that the company has under consideration a large addition to the factory space of its Barberton plant. Tentative plans call for a one-story building of brick and steel and of saw-tooth design similar to the other buildings of the plant. Dimensions of the addition under consideration are 110 x 275 feet. If carried to completion the new building will add 30,250 feet of floor space to the Sun plant.

H. D. Glass, sundry sales manager of the Seiberling Latex Products Company, will present the company's line of toys at the New York Toy Show, April 5-17. He will make his headquarters at the Hotel McAlpin. One of the newest members of Walt Disney's world of animal fantasy, Elmer Elephant, will be on display in the form of a rubber toy for the first time at the New York show, Mr. Glass said. Recently, Seiberling Latex announced that Pop Eye, The Sailor, had joined their family of comic strip and screen characters with his familiar face on a line of rubber balls.

A. E. Boss, assistant manager of special product sales, Columbia Alkali Corporation, Barberton, announces that facilities for a fifty per cent increase in the production of Calcene will be completed within the next sixty days. The added facilities, Mr. Boss said, were necessary to bring production to a point equal to the demand for this product.

While all of the smaller manufacturers of rubber specialties report business and prospects good for continued increase during the year, smaller manufacturers of tires complain of short profits from the high prices of cotton and rubber and emphasize the immediate need of further advance in tire prices. Off-the-record reports are current that there will be another advance in the price of tires sometime this month, or not later than early in April. Recent advances in wages and salaries tend to confirm these reports, according to persons who are in close touch with the trends of the industry.

H. H. Scheu, sales manager of the Eclat Rubber Company for the past five years, has resigned, his resignation to become effective March 15th, it was announced at the offices of the company. Mr. Scheu's plans, the announcement said, were indefinite and company officials said that no appointment has yet been made to fill the vacancy created by his resignation.

Dr. A. E. Warner, secretary of the Akron Group, Rubber Division, A.C.S., has announced that "Brownie" Gray, a United Air Lines pilot, will speak on the general subject of "Aeronautics" at the March 19th meeting of the Group. W. P. Fletin, district traffic manager of the air transportation company, promises an interesting program.

Predict New Tire Rise

Another upward adjustment of tire prices is predicted for the early future, with the increase running from 5 to 10%. This second increase is said to be inevitable in view of the recent wage boosts granted rubber workers, rising cotton prices and the high cost of crude rubber. Originally, the tire manufacturers planned to hold this increase until later in the year, but now it seems probable that it will be announced shortly, and a third will be made sometime in the Summer.

GOODRICH BUYS PLANT IN CADILLAC, MICH.

The B. F. Goodrich Company, Akron, has purchased the factory site and building formerly occupied by the Acme Motor Truck Company at Cadillac, Michigan. The building contains approximately 100,000 square feet of floor space and will be utilized for the manufacture of "a general line of rubber goods," according to Goodrich officials. For the present, no tire manufacturing is scheduled for the new plant, which, when placed in operation, will give employment to approximately 500 persons.

Goodrich has been conducting a survey for many months seeking a location for a new factory to supplement production of its general line of goods. It was understood that a tire plant was not particularly desired, since the Oaks, Pennsylvania, factory is being prepared for such production. The city of Cadillac was selected from a field of 28 competing cities, it is understood, the final factor being the preponderance of Nordic racial population and absence of labor troubles.

Ohio Rubber Expanding

Approximately 5,000 square feet of floor space is being added to one of the buildings of the Ohio Rubber Company, Willoughby, Ohio. A one-story addition, 40 x 120 feet, is being erected, including a loading dock of 20 foot width. The new building will cost approximately $15,000, according to report. This is the second addition to the Ohio Rubber factory in the last few months.

LOS ANGELES NEWS

Simultaneous action of Los Angeles' four largest rubber factories have brought pay rises totaling more than $750,000 to more than 5,000 wage earners for the year 1937, the increases being effective immediately at the time of announcement. Ross J. Cope, president, Firestone Tire and Rubber Company of California, announced a $200,000 increase this year for 1,500 employees. Goodyear Tire and Rubber Company increases will total approximately $300,000, all rubber and textile mill employees benefiting. U. S. Rubber increases will total about $125,000, affecting about a thousand employees of the Samson division. B. F. Goodrich Company increases affecting 1,000 employees will add $125,000 to contents of pay envelopes. Several smaller companies have also done considerable in the way of increased wages.

R. B. Stringfield, Los Angeles, member of the Los Angeles Group, Rubber Division, A.C.S., was recently elected chairman of the American Chemical Society for the division including California. At the March meeting of the Los Angeles Rubber Group the secretary was instructed to write him a letter extending the best wishes and congratulations of the group membership as a whole.

R. H. Eagles, vice-president of J. M. Huber, Inc., New York City, spent the latter part of February and first part of March in Los Angeles and San Francisco on business.

T. Kirk Hill, proprietor of the Kirkhill Rubber Company, 5801 S. Hoover Street, announces the addition of 3,600 feet of floor space to his factory. Forty employees have been added since January 1 and the factory is now running daily with three seven hour shifts. Kirkhill turns out more than 7,000 different rubber items, specialties being items used in the plumbing industry, and for sale in hardware stores and chain stores. Mr. Hill's experience is in line with the general trend in the area, the rubber industry as a whole experiencing good growth in volume in recent months.

Names in the News

WARREN T. LEWIS, purchasing agent, Firestone Tire and Rubber Company, Akron, was elected to membership on the Commodity Exchange, Inc., at a meeting of the Board of Governors last month. Privileges of the Exchange were granted Firestone through his membership.

H. S. KARCH, chemical engineer, Lima Cord Sole and Heel Company, Lima, Ohio, was recently elected to membership in the American Society for Testing Materials, Philadelphia.

STUART H. HAHN, of the Physical Research Laboratory, B. F. Goodrich Company, Akron, writes on "Rubber Mountings—for Large Industrial Machines" in the February, 1937, issue of *Product Engineering*.

WALTER B. HARDING, affiliated with the G & J sales division of U. S. Rubber Products, Inc., for a number of years, was recently elected president of the Cycle Trades of America. He is located at the U. S. Indianapolis plant.

G. L. W. WEBSTER, credit manager, Goodyear Tire and Rubber Company, Akron, has been named national chairman of the Automotive Tires Credit Group's 7th Congress, which will be held in Chicago June 21 to 24.

C. D. ROLLIN, western manager, Seiberling Tire Company of Canada, Ltd., has moved his headquarters from Winnipeg to Vancouver. He reported that business has improved considerably in the past few months.

FRANKLIN G. SMITH, president, Ohio Rubber Company, Willoughby, Ohio, and also president of the Osborn Manufacturing Company, was tendered a dinner and reception last month by associates in celebration of his 45 years of service with the Osborn concern.

S. T. CAMPBELL has resigned as vice-president and general manager of the Faultless Rubber Company, Faultless, Ohio. A few months previous he resigned as president and general manager of the Aetna Rubber Company, Cleveland, although he still retains a directorship in the latter concern.

DR. H. L. TRUMBULL, manager, chemical research laboratories, B. F. Goodrich Company, Akron, addressed high school teachers of chemistry, meeting at Akron University on February 20th, on "Industrial Research."

W. E. FOUSE, vice-president, General Tire and Rubber Company, Akron, was elected president of the Akron Y.M.C.A. recently. The appointment was effective on March 1st.

Forbes Resigns Armstrong Post

D. H. Forbes, development and production manager of the rubber division of the Armstrong Cork Company, Lancaster, Pennsylvania, for the past eight years, has resigned from the company. He had previously been connected with the Fairfield, Connecticut, plant of du Pont, in charge of spreading operations, and prior to that connection was associated with the predecessor company to the El Popo Rubber Manufacturing Company, in Mexico City, for four years. Mr. Forbes expects to leave for a trip abroad shortly, where he will spend several months before returning to the United States.

R. S. POPE, formerly personnel manager at the California plant, and for the last two years secretary to President P. W. LITCHFIELD, has been made assistant personnel manager of the Goodyear Tire and Rubber Company's Akron factories. He has been with Goodyear since 1919. A. B. MATTHEWS has been named manager of the Labor Department succeeding K. L. REYNOLDS whose duties will be announced later.

CHARLES EMIG has been appointed superintendent of the East Palestine (Ohio) factory of the National Tire and Rubber Corporation. He served with Goodyear for a number of years.

ROBERT L. MOORE, until recently associated with the Marshall Asbestos Company, Troy, N. Y., has joined the Johns Manville Corporation and will have charge of a new floor tile plant now being constructed at Manville, N. J.

WALTER H. GROTE, of the United Carbon Company, Charleston, West Virginia, sailed on the *S. S. Hansa* on March 7th for a trip abroad in the interests of his company. He will visit Germany, Austria, Belgium, Switzerland, France, England, Italy and Holland, and will be gone several months.

N. W. PICKERING was re-elected president of the Farrel-Birmingham Company, Inc., at a meeting of the board of directors held on February 18th at the company's main office at Ansonia, Conn. All other officers were also re-elected.

JOHN C. GRINDLAY has been appointed to cover the Kentucky, Southern Ohio and Southern Indiana territory for the Watson-Stillman Co., Roselle, N. J., manufacturers of hydraulic equipment. He will maintain headquarters at 83 South High Street, Columbus, Ohio. The company also recently appointed RICHARD W. DINZL as chief engineer. He was formerly with the Baldwin Southwark Company.

Advanced by Goodrich

S. B. Robertson

Samuel B. Robertson, vice-president and general manager of the B. F. Goodrich tire division, was appointed executive vice-president of the company, and elected to the directorate, at a meeting of the board of directors in Akron on February 16th. He succeeds on the board George M. Moffett, whose resignation was accepted at the meeting. Mr. Robertson was born in Milton, Mass., in 1878, and was graduated from the Massachusetts Institute of Technology in 1899, entering railroad service shortly thereafter. After a long and successful career with the Pennsylvania Railroad, serving at one time as general superintendent of its Central Division, he joined Goodrich in 1919 as assistant to the works manager and later became director of engineering. Following the construction of the Pacific Goodrich plant in Los Angeles in 1928, he was elected vice-president and general manager of that plant, continuing in that capacity until September, 1931, when he returned to Akron to head the tire division.

IRA G. NEEDLES, merchandising manager, tire division, B. F. Goodrich Company of Canada, Ltd., Kitchener, Ontario, completed 20 years of service with Goodrich recently. He joined the company in 1916 and served in Akron, New York and Philadelphia, before being transferred to Canada in 1925.

J. H. WINCHESTER, credit manager, Ohio Rubber Company, Willoughby, Ohio, has been awarded the Dartnell Gold Medal for writing one of the best business letters during 1936. Over 4,000 contestants competed for the medal.

E. R. BRIDGWATER, Rubber Chemicals Division, E. I. du Pont de Nemours and Co., Inc., Wilmington, Delaware, sailed for Europe on February 10th where he will visit England, France and Germany on a combined business-pleasure trip.

Financial News

B. F. GOODRICH EARNS $7,319,507 FOR 1936

Net profit for the year ended December 31, 1936, after depreciation, interest and provision for Federal income and undistributed profits taxes, is reported at $7,319,507 by the B. F. Goodrich Company, Akron. This profit, the largest since 1929, represents an increase of more than 113% over the $3,429,781 reported for 1935. Consolidated net sales amounted to $141,097,136, an increase of 17.6% over those of the previous year.

The 1936 profit is equal to $4.03 a common share after provision for preferred stock dividends, which compares with $1.18 a common share earned in 1935. The directors also voted a dividend of $1.25 per share on the $5.00 cumulative preferred stock, payable March 31st to holders of record at the close of business on March 26th.

Total current assets at the close of the year amounted to $82,276,928, as compared with current liabilities of $14,949,958, a ratio of 5.5 to 1. Net current assets increased $12,677,862 during the year, according to the report.

U. S. RUBBER PROFIT EXCEEDS $10,000,000

For the first time in slightly over ten years, net profit of the United States Rubber Company, and subsidiaries, totaled more than $10,000,000 for a calendar year. Net income for the year ended December 31, 1936, after deducting all charges (including provision for the surtax on undistributed profits) amounted to $10,172,484, an increase of $3,640,247 over net income of the previous year.

Although under a provision in the first and refunding mortgage indenture of 1917 U.S. Rubber can pay no dividends until its deficit is eliminated, the 1936 profit is equivalent to $3.31 a share on the 1,497,531 common shares outstanding, assuming a distribution on the 8% cumulative preferred stock. The 1935 profit was equivalent to 90 cents a share.

Net sales totaled $160,361,026, an increase of $32,567,411 or 25% over the previous year. Included among the deductions was a reserve of $700,000 to provide for the wide fluctuations, under present economic conditions, in market prices of both crude rubber and cotton. The report shows a total employment of 32,536 persons for the year, with total salaries and wages paid amounting to $43,343,000. Total current assets, as of December 31st, amounted to $80,646,728, including $12,822,619 in cash, against total current and accrued liabilities of $23,693,401, a ratio of 3.4 to 1.

A profit of $3,585,088 before provision for depreciation and amortization of $1,671,298, which resulted in a net profit of $1,913,790 for the year of 1936 is reported by U.S. Rubber Plantations, Inc. This net is not included in the report of the parent company, but is shown on a separate statement. The 1936 income approximately doubled the $967,695 reported in the previous year. During the year 41,594,000 pounds of crude rubber were shipped, which compares with 40,004,000 pounds in 1935. Approximately 99,000 acres of trees have been planted with 98,000 acres in maturity. The average yield per acre during 1936 was 551 pounds. A total of 11,684 employees were required to operate the plantations during the year.

Hewitt Files Statement

A registration statement has been filed by the Hewitt Rubber Corporation with the Securities and Exchange Commission anticipating a public offering of 57,430 shares of common stock, according to Thomas Robins, Jr., president. The offerings will be made by an underwriting group headed by F. Eberstadt and Company, Inc., New York City. This registration follows the recent issuance to each stockholder of two shares of $5.00 par value for each share of $10.00 par formerly held, making a total of 116,188 shares outstanding. Of the 57,430 shares to be offered, 52,000 represent new shares to be issued and sold, from the proceeds of which Hewitt will redeem all of its outstanding bonds and debentures.

Raybestos-Manhattan Gains

Net income of Raybestos-Manhattan, Inc., Passaic, N. J., for 1936 was $1,691,496, or $2.66 a share, after providing $687,695 for depreciation, $405,602 for Federal and state income taxes, $132,000 for the surtax on undistributed profits, and payment of $139,103, or the equivalent of 22 cents per share, to employees at Christmas. In the previous year, Raybestos-Manhattan reported a net profit of $1,374,423, or $2.16 per share. Total assets as of December 31st amounted to $18,839,512, including $9,548,237 of current assets. The company has no banking or funded debt, or other capital obligations outstanding.

Converse to Issue Shares

The Converse Rubber Company, Malden, Mass., filed a registration statement with the Securities and Exchange Commission on February 18th covering the proposed issuance of 25,000 shares of $2.00 cumulative prior preferred convertible stock.

United Carbon Net Higher

For the year ended December 31, 1936, the United Carbon Company, Charleston, West Virginia, reports a net income of $2,202,850, after depreciation, depletion, minority interests, Federal and state income taxes and $53,000 surtax on undistributed earnings. The profit is equivalent to $5.54 each on 397,885 shares of no-par common stock outstanding, and compares with net profit of $1,872,405, or $4.70 a common share, reported for 1935. Current assets are listed at $2,752,369 against current liabilities of $912,199.

Offer Pharis Shares

Public offering of 130,632 shares of $1.00 par value of the new Pharis Tire and Rubber Company, Newark, Ohio, was made last month by G. L. Ohrstrom and Company, Inc., and Stevenson, Vercoe, Fuller and Lorenz, at $10.00 per share. Included in this offering was 58,555 shares which represent new financing. It was understood that net proceeds from the sale of the stock will be used to discharge a $300,000 bank loan, and the remainder for ordinary business purposes.

Armstrong Earns $5,277,534

Net income of the Armstrong Cork Company, Lancaster, Penna., including the Stedman Rubber Flooring division, amounted to $5,277,534 for 1936, after interest, depreciation, allowance for Federal income tax and surtax on undistributed profits. This is equal to $4.36 a share of common stock, and compares with a net of $3,434,912, or $2.84 a share, in 1935.

Profit for Baldwin Rubber

After providing $52,310 surtax on undistributed earnings, net profit of the Baldwin Rubber Company, Pontiac, Michigan, for 1936 totaled $483,519, equal to $1.74 each on 278,604 shares. This compares with a net profit of $434,050, or $1.56 each on 278,611 shares, in the previous year, after complete conversion of old Class A and B stocks and thereafter a four-for-one split.

Loss for Aetna Rubber

For the year of 1936, the Aetna Rubber Company, Cleveland, Ohio, reports a net loss of $10,836, which compares with $81,727 loss in the previous year. The company has been cutting down its annual losses over a period of years, loss in 1934 having been reported at $107,880.

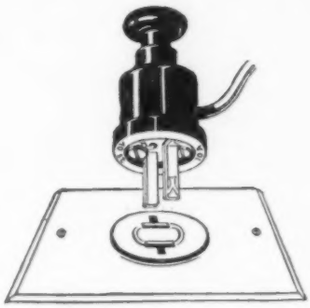
Dryden Increases Profit

Net income of the Dryden Rubber Company, Chicago, Illinois, for the twelve months ended December 31, 1936, after surtax on undistributed profits, amounted to $377,229, which compares with net income of $211,942 reported for 1935.

New Rubber Goods

Wedgelock Electric Plug

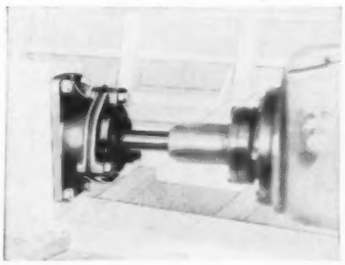
The Wedgelock Electric Plug, which incorporates a rubber housing and a rubber plunger, has been placed on the market by the Hy-Duty Products Cor-



poration, Los Angeles, California. Pressure of the hand on the rubber plunger, or ram, causes an auxiliary bayonet-like wedge to slide along each of the two contact prongs into the receiving socket. This action provides for a tight connection on electrical cords used in the home, office and factory. Entrance for the extension cord attachment to the Wedgelock plug is through the side of the rubber housing rather than the customary rear entrance. To release the plug, the rubber plunger is pulled back, thus breaking the "lock."

Cushion Stuffing Box

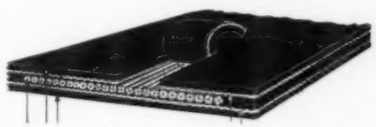
The Equi-Flex cushion stuffing box, primarily designed for use in the marine field, but adaptable to industrial uses, has been introduced by the Federal-



Mogul Corporation, Detroit, Michigan. It is particularly suited to closely-coupled, flexibly-mounted marine engines and interchangeable with all standard inboard stuffing boxes and shaft logs. The complete unit consists of a metal body which is mounted in rubber, with a metallic sleeve vulcanized directly to it. Where there is unusual exposure to oil, neoprene (formerly called DuPrene) may be substituted for the rubber mounting, according to the manufacturer. The degree of flexibility of the entire unit can be controlled through the material selected for the flexible element. The illustration shows a typical motor boat installation of the new self-adjusting, self-lubricating cushion stuffing box.

Condor Granite Sling Belt

Engineered especially to give maximum wear in the severe service encountered in the granite, stone and marble industries, the Condor Granite Sling Belt has been developed by the Manhattan Rubber Manufacturing Division of Raybestos-Manhattan, Inc., Passaic, N. J. The endless construction of the belt permits the stone to be rotated in the sling at any angle, while safety is increased, handling and cutting time saved and polished surfaces are not injured. The new Condor belt is said to have a high degree of bending flexibility, no splice in the load-carrying section, and does not strip or slip on the stone. The belt consists of three major parts, e.g., a stretchless and endless-cord strength member set in a cushion of rubber; a top and bottom covering of cotton duck to provide lateral rigidity; and a cover on top



and bottom of thick tire-tread rubber, all three parts being vulcanized together in one unit. Furnished in lengths from 10 to 18 feet, varying 6 inches between sizes, the belt permits a safe load of 1,000 pounds per inch of belt width.

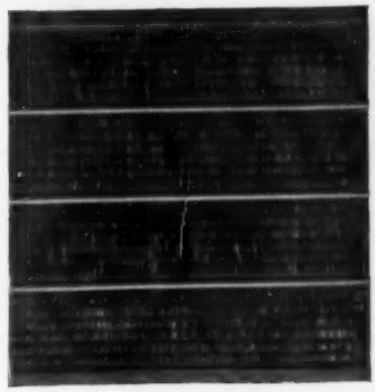
Rubber Wall Plugs

An expanding, non-splitting rubber wall plug, termed Craftplug, is being marketed by Craftplug, Inc., 145 East 57th Street, New York City. Made entirely of rubber, Craftplugs may be cut to any desired length, combine elasticity with holding power, absorb shock and vibration and can be used in any material. They are practically indestructible and are unaffected by heat, cold or moisture. Screws of three different diameters may be used with the same Craftplug. The company also features

stud bolts and anchors in which the expanding member is made of rubber. The illustration shows a strip of Craftplug, already inserted in the wall, being cut to measure.

Spintex Battery Separator

A new type of battery separator, called Spintex, has been introduced to the automotive market by Globe-Union, Inc., Milwaukee, Wisconsin. Spintex is a rub-



berized fabric, of ribbed construction, and resembles a standard cedar separator in appearance. It is said to have the advantage of compactness, an important point where battery separators are concerned. Claims made for the new separator include: high degree of porosity, which permits free, fast circulation of the active power-creating materials; durability, said to match the life of the plates themselves; withstands pressure when plates buckle; and increases battery life by one-sixth.

Footsure Bath Mats

Under the trade-name of Footsure, a line of rubber bathtub and shower mats is being featured by the Footsure Company, Inc., 1220 Maple Avenue, Los Angeles, California. All models in the line, one of which is illustrated herewith, have small holes to permit the mats to sink to the bottom of the tub if placed in the water after the bath

has been drawn, cross ridges on the surface for secure footing, ridges on the underside to prevent side-slipping, and annular vacuum cups which double-lock the mat to slippery surfaces which make for a stronger vacuum. In addition to these features, the Footsure DeLuxe model has a large hole in its center to be placed over the drains in shower stalls, in addition to being constructed with extra cross ridges on the underside. Available in a variety of colors, Footsure mats range from 16 x 24 inches to 18 x 32 inches in size.

MARKETS

RUBBER—COTTON AND FABRICS—CHEMICALS

NEW YORK, MARCH 9, 1937

Crude Rubber

CRUDE rubber prices strengthened considerably immediately after the settlement of the 42-day General Motors strike last month but lost ground shortly thereafter, although publication of January consumption figures favored the market. For the balance of February the price for spot on the Exchange hovered around the 21 cent mark rising sharply during the closing days of the month based on the strengthening of foreign markets. High for spot on the Exchange for the period was 22.88 on March 6th; low was 20.74 on February 19th. Because of quiet but persistent factory buying in the past few days the price of crude has climbed rapidly, a surge of profit taking, however, holding back the advance slightly in the last two days. This advance is also partially attributable to a growing belief that producers will not be able to turn out their alloted quotas. Demand, apparently, is almost meeting current supply, while available stocks continue to diminish. There are also rumors of growing labor discontent in rubber cultivating centers, especially in Malayan districts. Quotations in the outside market, Exchange, London and Singapore, follow:

As of March 9

Plantations—

Ribbed Smoked Sheets—			
No. 1 Spot	—	@	.22⅝
April-June	—	@	.22⅛
July-September	—	@	.22⅞
No. 2	—	@	.22⅜
No. 3	—	@	.22½
No. 4	—	@	.22⅞
Thin Latex Crepe	—	@	.25½
Thick Latex Crepe	—	@	.25½
Brown Crepe, No. 1	—	@	.22⅝
Brown Crepe, No. 2	—	@	.22⅛
Amber Crepe, No. 2	—	@	.22⅜
Amber Crepe, No. 3	—	@	.22⅛
Amber Crepe, No. 4	—	@	.22⅞
Brown Crepe, Rolled	—	@	.21⅝

Latex—

Liquid Latex, per gal.	.83	@	.84

Paras—

Up-River, fine	—	@	.25
Acre Bolivian, fine	—	@	.25

Balata—

Block, Ciudad	—	@	.30

LONDON MARKET

Standard Smoked Sheets—Buyers—March 9			
April-June	—	@	11¼d
July-September	—	@	11⅜d

SINGAPORE MARKET

Standard Smoked Sheets—Sellers—March 9			
April-June	—	@	10¹¹⁄₁₆d
July-September	—	@	10¾d

Reclaimed Rubber

Despite the current industrial position, with strikes, sit-downs and lock-outs interfering almost constantly with organized production, reclaimers report a continued demand. They view the future with confidence because of statistics which indicate that crude rubber demand is outstripping supply, which means higher crude rubber prices. There have been no changes since our last report. Current quotations follow:

Shoe

Unwashed ....lb.	.06¾	@	.07
Washed ....lb.	.08¼	@	.09

Tube

No. 1 (Floating)....lb.	.19	@	.19¼
No. 2 (Compounded)....lb.	.08¾	@	.09
Red tube ....lb.	.08¾	@	.09¼

Tires

Black (acid process)....lb.	.06¾	@	.07
Black, selected tires....lb.	.05¾	@	.06
Dark Gray ....lb.	.08	@	.08½
White ....lb.	.14	@	.14½
Truck, Heavy Gravity....lb.	.05¾	@	.06¼
Truck, Light Gravity....lb.	.06¼	@	.06½

Miscellaneous

Mechanical blends ....lb.	.04¼	@	.04¾

Scrap Rubber

(Delivered Akron Mills)

Scrap prices have gone up fractionally on several grades since our last report, including mixed auto, beadless tires and inner tubes. Dealers report stocks are moving freely. Demand continues active with a long pull in sight. Current quotations follow:

(Prices to Consumers)

Auto tire peelings....ton	19.00	@	—
Mixed auto....ton	14.00	@	—
Beadless tires....ton	17.00	@	18.00
Clean solid truck tires....ton	28.00	@	30.00
Boots and shoes....ton	17.50	@	20.00
Arctics, untrimmed ....ton	12.50	@	15.00
Inner tubes, No. 1....lb.	.12	@	.13
Inner tubes, No. 2....lb.	.05⅜	@	.05½
Inner tubes, Red....lb.	.05⅜	@	.05½

Cotton

After declining steadily but slowly in mid-February, due to uncertainties in the economic position of industry, touching 12.95 for spot on February 20th, cotton prices took a sudden turn upward and have climbed into new highs in the past two weeks, reaching 14.27 on March 9th, high for the period. The price climb is attributed to trade scares on the theory that cotton is seriously underpriced in relation to other commodities. The manner in which loan cotton is being absorbed, the extent of the European rearmament program, the current rate of retail distribution and wage increases, together with an improved outlook for a balanced world supply and demand supports this theory. Current strength of the market is said to hinge upon the filling of trade requirements, buyers appearing to be apprehensive as to higher costs in the early future, although the future market gives no such indication. Prices have been rather erratic, therefore, in the past ten days, ranging from a 13.50 quotation for spot on March 1st to a 14.27 price today (March 9th). Higher prices are anticipated. Quotations for middling uplands on the N. Y. Cotton Exchange follow:

	Feb. 9	March 9		
	Close	High	Low	Close
March	12.66	14.10	13.78	14.07
June	12.54	13.59	13.59	13.59
September	12.08	13.24	13.24	13.24

Tire Fabrics

(Prices Net at the Mill)

Peeler, carded 23/5/3....lb.	.36¾	@	.37
Peeler, carded, 23/4/3....lb.	.37¾	@	.38
Peeler, carded, 15/3/3....lb.	.34¾	@	.35
Peeler, carded, 13/3/3....lb.	.33¾	@	.34
Egyptian, carded, 23/5/3....lb.	.49	@	.49½
Egyptian, combed, 23/5/3....lb.	.54	@	.54½
CHAFERS			
Carded, American, 1 1/16"....lb.	.34½	@	.35½
Carded, American, 1"....lb.	.29½	@	.34

Sheetings

48x40	36 in.	5.50	....lb.	— @	.06⅜
40x40	36 in.	6.15	....lb.	— @	.06¾
40x36	36 in.	6.50	....lb.	— @	.06
48x48	40 in.	2.50	....lb.	— @	.12
48x48	40 in.	2.85	....lb.	— @	.10¾
56x60	40 in.	3.60	....lb.	— @	.10¾
48x44	40 in.	3.75	....lb.	— @	.08⅝
44x40	40 in.	4.25	....lb.	— @	.07⅞

Ducks

Enameling (single filling)....lb.	.31	@	.34
Belting and Hose....lb.	.30	@	—
Single filling, A grade....lb.	.14½	@	.15
Double filling....lb.	.15¼	@	.16

Closing Rubber Prices on New York Commodity Exchange, Inc.

No. 1 Standard Contract of 10 tons

FROM FEBRUARY 10 TO MARCH 9

Date		Spot	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Sales
Feb.	10	21.41	21.37	21.40	21.45	21.49	21.49	21.49	21.49	21.46	21.48	21.48	21.49	21.48		143
	11	21.53	21.52	21.55	21.60	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65		486
	12															
	13															
	14															
	15	21.22	21.14	21.17	21.24	21.32	21.35	21.38	21.37	21.36	21.37	21.37	21.36	21.36		375
	16	21.03	21.02	21.05	21.13	21.22	21.21	21.21	21.21	21.22	21.24	21.24	21.25	21.25		295
	17	21.09	21.08	21.11	21.21	21.30	21.30	21.30	21.30	21.32	21.32	21.32	21.32	21.32		125
	18	20.81	20.78	20.80	20.87	20.90	20.92	20.93	20.97	20.98	20.98	20.98	20.98	20.98		371
	19	20.74	20.69	20.72	20.81	20.89	20.89	20.89	20.89	20.90	20.91	20.92	20.93	20.93		175
	20	21.00	20.94	20.96	21.04	21.12	21.15	21.18	21.19	21.21	21.21	21.21	21.21	21.21		189
	21															
	22															
	23	21.31	21.32	21.34	21.40	21.47	21.52	21.58	21.59	21.60	21.60	21.60	21.60	21.60		585
	24	21.72	——	21.70	21.78	21.86	21.92	21.98	22.00	22.00	22.00	22.00	22.00	22.00		569
	25	21.85	——	21.82	21.90	21.98	22.07	22.14	22.18	22.20	22.22	22.24	22.26	22.29		854
	26	21.85	——	21.80	21.88	21.95	22.01	22.07	22.07	22.09	22.10	22.12	22.13			307
	27	21.85	——	21.85	21.90	21.93	22.00	22.10	22.12	22.13	22.13	22.13	22.13	22.14		102
	28															
Mar.	1	21.80	——	21.80	21.88	21.96	22.03	22.10	22.12	22.13	22.12	22.12	22.12	22.15	22.15	286
	2	21.85	——	21.81	21.90	21.99	22.07	22.14	22.16	22.18	22.18	22.18	22.18	22.19	22.19	102
	3	21.88	——	21.70	21.80	21.90	21.97	22.04	22.05	22.06	22.07	22.08	22.10	22.11	22.11	179
	4	21.93	——	21.90	21.98	22.05	22.13	22.21	22.23	22.22	22.25	22.26	22.27	22.28	22.28	196
	5	22.53	——	21.90	21.98	22.05	22.13	22.21	22.23	22.22	22.25	22.26	22.27	22.28	22.28	649
	6	22.88	——	22.85	22.96	23.07	23.12	23.16	23.20	23.20	23.25	23.27	23.30	23.31	23.31	587
	7															
	8	22.63	——	22.60	22.65	22.71	22.80	22.88	22.91	22.94	22.96	22.98	23.00	23.02	23.02	643
	9	22.63	——	22.62	22.67	22.71	22.78	22.85	22.86	22.87	22.90	22.91	22.92	22.93	22.93	344

Rubber CHEMICAL Markets

NEW YORK, MARCH 12, 1937

[All Quotations F.O.B. Works Unless Otherwise Noted]

ACCELERATORS

Organic			
A-1 (Thiocarbanilid)	lb.	.24 @	.28
A-5-10	lb.	.33 @	.36
A-7	lb.	.53 @	.65
A-11	lb.	.60 @	.75
A-16	lb.	.55 @	.65
A-19	lb.	.56 @	.75
A-32	lb.	.70 @	.80
A-77	lb.	— @	—
Aldehyde ammonia, crystals	lb.	.65 @	.70
Altax	lb.	— @	—
Captax	lb.		
Crylene	lb.	.55 @	.65
paste	lb.	.45 @	.55
Di-Ortho-Tolyguanidine	lb.	.44 @	.47
Diphenylguanidine	lb.	.35 @	.37
El-Sixty	lb.	.55 @	.65
Ethylidene aniline	lb.	.45 @	.47½
Formaldenyde aniline	lb.	.37½ @	.42
Guantal	lb.	.42 @	.51
Heptene	lb.	.40 @	—
Hexamethylene-tetramine	lb.	.37 @	—
Lead Oleate, No. 999	lb.	.12 @	—
Witco	lb.	.12 @	—
Lithex	lb.	.18 @	.20
Methylenedianiline	lb.	.36 @	.37
Monex	lb.	3.25 @	—
Oxynone	lb.	.68 @	.80
Phenex	lb.	.50 @	.55
Pipsolene	lb.	1.60 @	1.85
R & H 40	lb.	.40 @	.41
R & H 50	lb.	.40 @	.41
R-2	lb.	1.50 @	1.80
Safex	lb.	1.20 @	1.25
SPDX	lb.	.75 @	—
Super-Sulphur No. 1	lb.		
No. 2	lb.		
Thiocarbanilid, drums	lb.	.24 @	.28
Trimene	lb.	.75 @	—
base	lb.	1.20 @	—
Triphenylguanidine	lb.	.58 @	.60
Tuads	lb.		
Ureka	lb.	.62 @	1.00
Ureka B	lb.	.62 @	.75
Ureka C	lb.	.58 @	.69
Vulcanex	lb.		
Vulcone	lb.		
Vulcanol	lb.		
Z-88-P	lb.	.48 @	.60
Zimate	lb.		
Inorganic			
Litharge, domestic	lb.	.07½ @	.08½
Magnesia, calcined, heavy	lb.	.04 @	—

COLORS

Blacks (See Compounding Materials)			
Blues			
Prussian	lb.	.37 @	.39
Ultramarine	lb.	.15 @	—
Browns			
Sienna, Italian	lb.	.06 @	'13
Umber, Turkey	lb	.04 @	.04½
Greens			
Chrome, light	lb.	.20 @	.30
medium	lb.	.21 @	.31
Chromium Oxide, bbl.	lb.	.19 @	.20
Guignet's Green	lb.	.70 @	—
Reds			
Antimony			
crimson, 15/17	lb.	.48 @	—
sulfur, free	lb.	.48 @	.60
Indian English	lb.	.09 @	.10
Domestic (Maroon)	lb.	.11 @	—
Red oxide, pure	lb.	.10 @	.12
Rub-Er-Red, f.o.b. Easton	lb.	.09¼ @	—
Whites			
Cryptone CB, No. 21	lb.	.05¾ @	.06
Cryptone, No. 19	lb.	.05¾ @	.06
Cryptone, ZS-20	lb.	.09 @	.09¼
Cryptone, ZS-86	lb.	.09 @	.09¼
Lithopone			
Albalith, black label—11 lb.		.04¼ @	.04½
Azolith	lb.	.04¼ @	.04½
Rayox	lb.		
Titanox A	lb.	.16 @	.16¾
Titanox B	lb.	.05¾ @	.06
Titanox C	lb.	.05¾ @	.06
Zinc Oxide—American Process			
American Azo			
ZZZ (lead free)	lb.	.05¼ @	.05½
Anaconda, lead free	lb.	.05¼ @	.05½
Horsehead Lead Free Brand:			
Special—3	lb.	.05¼ @	.05½
XX Red—4	lb.	.05¼ @	.05½
XX Red—72	lb.	.05¼ @	.05½
XX Red—78		.05¼ @	.05½
XX Red—103	lb.	.05¼ @	.05½
U. S. P.—7, bbls.	lb.	.05¼ @	.05½
Kadox, black label—15	lb.	.05¼ @	.05½
Blue label—16	lb.	.05¼ @	.05½
Red label—17	lb.	.05¼ @	.05½
St. Joe, black label	lb.	.05¼ @	.05½
green label	lb.	.05¼ @	.05½
red label	lb.	.05¼ @	.05½
Zinc Oxide—French Process			
Florence White seal—7 bbls.	lb.	.06¾ @	.07
Green seal——8	lb.	.06¼ @	.06½
Red seal—9	lb.	.05¾ @	.06
Yellows			
Chrome	lb.	.11 @	.12
Ocher, dom. med.	lb.	.02¾ @	—

BLACKS

Arrow "Aerfloted" Specification	lb.	.0535 @	.0825
Bone, powdered	lb.	.05½ @	.12½
Carbon, compressed	lb.	.0535 @	.0825
uncompressed	lb.	.0535 @	.0825
"Certified," Cabot	lb.	.0535 @	.0825
Spherons	lb.	.0535 @	.0825
"Disperso"	lb.	.0535 @	.0825
Drop, bbls.	lb.	.05½ @	.14
"Excello," compressed	lb.	.0535 @	.0825
"Fumonex"	lb.	.03 @	.07
"Gastex"	lb.	.03 @	.07
Lampblack	lb.	.07 @	.12
"Micronex"	lb.	.0535 @	.0825
"Supreme"	lb.	.0535 @	.0825
Thermatomic—"P 33"	lb.	— @	—
"Thermax"	lb.	— @	—
United "Dixie" & "Kosmos"	lb.	.0535 @	.0825

COMPOUNDING MATERIALS

Aluminum Flake	ton.	21.85 @	24.50
Ammonia carbonate, lump	lb.	.10½ @	.12
Asbestine	ton	13.00 @	15.00
Barium carbonate (98-100%)	ton	56.50 @	61.50
Barium Dust	lb.	.05 @	.06
Barytes	ton	23.65 @	31.15
Basofor	lb.	.04½ @	—
Bentonite	lb.	.02 @	.03
Blanc fixe dry f.o.b. works	ton	70.00 @	75.00
Calcene	ton	37.50 @	45.00
Catalpo (fact.)	lb.	.02 @	—
Chalk, precipitated			
Suprex white, extra lt.	ton	45.40 @	60.00
heavy	ton	45.00 @	55.00
Clay, Kaolin, domestic	ton	7.50 @	15.00
Aerfloted, Suprex	ton	8.50 @	10.00
Congaree	ton	9.00 @	—
Dixie	ton		
Dixie, Jr.	ton		
McNamee	ton		
Par	ton		
Tensulite		15.00 @	—
Witco	ton	8.50 @	9.00
Cotton Flock	lb.	.11 @	.15
Glues, extra white	lb.	.28 @	.30
medium white	lb.	.14 @	.19
Kalite No. 1	ton	30.00 @	55.00
Kalite No. 3	ton	40.00 @	65.00
"Lime Crest" Industrial Filler No. 100	lb.	— @	—
Magnesium carbonate	lb.	.08 @	—
Mica	ton	35.00 @	—
Pyrax A	ton	— @	—
Rottenstone (powdered)	lb.	.02½ @	.05
Soapstone, powdered	ton	16.00 @	22.00
Starch, powdered	cwt.	2.90 @	4.10
Talc, domestic	ton	16.00 @	18.00
Whiting, commercial	ton	17.00 @	18.00
Columbia Filler	ton	9.00 @	14.00
English Cliffstone	ton	33.00 @	43.00
Witco	ton	7.00 @	—
Wood Flour	ton	18.00 @	30.00
Zinc Carbonate	lb.	.10½ @	.11
Zinc Stearate	lb.	.27 @	—

MINERAL RUBBER

Black Diamond	ton	27.00 @	—
Genasco, solid (factory)	ton	25.00 @	27.00
Hard Hydrocarbon	ton		
Parmr, solid	ton	25.00 @	—
Pioneer, MR, solid	ton		
Pioneer-granulated	ton		

SPECIALTIES

Aromatics—Rodo	lb.		
Para-Dors No. 5145	lb.	2.00 @	—
Sunproof	lb.	.35 @	.37½
Sponge Paste	lb.	— @	.80
Tonox	lb.	.56 @	.60

SOFTENERS

Acids			
Acetic, 28%, bbls.	100 lb.	2.45 @	2.70
Nitric, 36 degrees	cwt.	5.00 @	6.00
Sulfuric, 66 degrees	ton	15.50 @	16.50
Acids, Fatty			
Laurex	lb.	.15 @	.16
Stearex Beads	lb.	.10½ @	.11
Stearic, double pressed	lb.	.11½ @	.12½
Stearite	lb.	.10½ @	.11½
Alkalies			
Caustic Soda, 76%	cwt.	3.05 @	—
Soda Ash, 58% C.L.	cwt.	1.25 @	—
Oils			
Corn, refined, bbls.	lb.	.12¾ @	—
Cottonseed, crude	gal.	.093 @	.10
Cycline Oil	gal.	.15 @	.28
Degras, bbls.	lb.	.07¾ @	.08
Fluxrite	lb.	.06½ @	.06½
Palm Lagos	lb.	.06 @	—
Niger	lb.	.06½ @	.06¾
Para Flux	gal.	.17 @	—
Petrolatum, light	lb.	.03⅛ @	.03⅜
Pigmentaroil, tank cars	gal.	.16 @	—
in drums	gal.	.22 @	.23½
Pine, steam distilled	gal.	.64 @	.65
dest. dist., drums	gal.	.50 @	—
Rosin Oil, cmpd	gal.	.40 @	—
Rubtack	lb.	.08 @	.10
Seedine, c.l.	lb.	.07¼ @	—
Tackol	lb.	.08½ @	.18
Witco Palm Oil	lb.	.07 @	—
Witco Softener	gal.	.18 @	—
Woburn No. 8, c.l.	lb.	.06 @	—
Wobonite, c.l.	lb.	.05 @	—
Resins and Pitches			
Pitch, Burgundy	lb.	.03½ @	—
coal tar	gal.	.07½ @	.08
hardwood	ton	15.00 @	—
pine, 200 lb. gr. wt.	bbl.	5.00 @	5.25
Rosin, grade K, 280 lb.	bbl.	10.95 @	—
Pigmentar, tank cars	gal.	.19 @	—
in drums	gal.	.25 @	.27
R. S. L. Resin	lb.	— @	—
Retort Pine Tar, drums	bbl.	12.00 @	13.00
Solvents			
Acetone, pure	lb.	.06 @	—
Alcohol, denatured, methanol, No. 1 bbls.	gal.	.28 @	.39
Benzene, 90%	gal.	.18 @	.23
Beta-Trichlorethane	gal.	— @	—
Bondogen	lb.	— @	—
Carbon, bisulfide	lb.	.05¼ @	.08
Carbon, tetrachloride	lb.	.05¾ @	—
Dichlorethylene	lb.	.29 @	—
Dipentene, cmi., drums	gal.	.41 @	.44
Dryolene (f.o.b. Okla.)	gal.	.10 @	.10½
Ethylene dichloride	lb.	.05½ @	.06½
Gasoline, steel bbls.	gal.	.16 @	—
Naphtha, solvent	gal.	.31 @	—
Plastogen	lb.		
Reogen	lb.		
Rub-Sol (f.o.b. Okla.)	gal.	.09 @	—
Trichlorethylene	lb.	— @	.09½
Turpentine, spirits	gal.	.50 @	—
dest. dist., drums	gal.	.47 @	—
Waxes			
Beeswax, white	lb.	.38 @	.40
Carnauba, yellow	lb.	.46 @	.47½
Ceresin, white, dom.	lb.	.08 @	.11
Montan, crude	lb.	.10¾ @	.11¾
Paraffin (c.l.—f.o.b. N. Y.)			
Yellow crude scale	lb.	.03½ @	—
White crude scale 124/126	lb.	.03 @	—
Refined, 122/127	lb.	.04½ @	—

ANTI-OXIDANTS

AgeRite, Gel	lb.		
HP	lb.		
Powder	lb.		
Resin	lb.		
White	lb.		
Albasan	lb.	.70 @	.75
Antox	lb.		
B-L-E	lb.	.57 @	.60
Flectol-H	lb.	.54 @	.65
Flectol White	lb.	.95 @	1.15
Flectol B	lb.	.54 @	.65
Neozone	lb.		
Oxynone	lb.	.66 @	.75
Perfectol	lb.	.67 @	.75
Retardex	lb.	.35 @	.40
Santoflex A	lb.	— @	—
Stabilite	lb.	.57 @	.62
Stabilite Alba	lb.	.70 @	.75
VGB	lb.	.55 @	.60

MOLD LUBRICANTS

Aresklene	lb.	— @	—
Cocoa Soapstock	lb.	.06 @	.08
Dipex	lb.	.06 @	.08
Lubrex	lb.	.25 @	.30
Rusco, f.o.b. Nitro	lb.	.12 @	.30
Sericite, f.o.b. N. Y.	ton	65.00 @	—
Soap Tree Bark, cut, sifted	lb.	.06 @	.08

FACTICE OR RUBBER SUBSTITUTES

Amberex	lb.	.23 @	—
Black	lb.	.08½ @	—
White	lb.	.095 @	.15
Brown	lb.	.095 @	.14
Neophax	lb.	.13 @	—

VULCANIZING INGREDIENTS

Sulfur Chloride, yellow (drs.)	lb.	.03½ @	.04½
Sulfur flour.			
Refined, 100% pure (bags)	cwt.	2.55 @	3.15
Commercial (bags)	cwt.	1.60 @	2.35
Telloy	lb.		
Vandex	lb.		

Crude Rubber
Latex and Guayule
Reclaimed Rubber
Tires and Tubes

STATISTICS OF THE INDUSTRY

Rim Production
Automobiles
Gasoline
Cotton Prices

U. S. Imports and Exports of Crude Rubber

YEARS	Gross Imports: Long Tons	Gross Imports: Total Declared Value	Gross Imports: Average Declared Value per pound Cents	Re-exports: Long Tons	Re-exports: Total Declared Value	Re-exports: Average Declared Value per pound Cents	Net Imports: Long Tons
1922	301,076	101,843,188	15.10	4,809	1,921,828	17.84	296,267
1923	309,362	185,060,304	26.71	8,772	5,672,319	28.87	300,590
1924	325,899	173,367,272	23.75	10,309	6,057,637	26.23	315,590
1925	393,370	426,167,504	48.36	14,827	19,847,753	59.76	378,543
1926	409,944	501,131,064	54.57	17,671	22,470,583	56.77	392,273
1927	424,733	338,688,492	35.60	27,775	24,735,488	39.76	396,958
1928	432,633	242,727,423	25.05	32,159	18,128,761	25.17	400,474
1929	560,082	239,177,811	19.06	36,485	16,868,718	20.64	523,597
1930	482,083	139,133,048	12.88	30,205	9,310,205	13.76	451,878
1931	497,176	72,922,845	6.55	25,595	4,255,572	7.42	471,581
1932	409,556	31,936,459	3.48	20,930	2,015,612	4.30	388,626
1933	407,817	44,034,064	4.82	20,537	2,601,352	5.65	387,280
1934	449,513	97,929,676	9.73	23,848	5,770,109	10.80	425,665
1935	453,134	115,299,448	11.36	11,389	3,084,331	12.09	441,745
1936	467,064	152,072,496	14.54	12,581	4,488,223	15.93	454,483
1935:							
June	31,240	7,523,598	10.75	524	153,595	13.10	30,716
July	46,987	11,666,577	11.08	489	132,173	12.06	46,498
August*	40,275	10,422,625	11.55	476	130,464	12.23	39,799
Sept.	34,659	8,637,048	11.12	468	120,438	11.48	34,191
Oct.	35,091	8,742,222	11.12	651	188,518	12.92	34,440
Nov.*	25,155	6,164,454	10.94	380	101,793	11.95	24,775
Dec.	38,417	9,930,710	11.54	1,821	523,997	12.85	36,596
1936:							
Jan.*	32,310	8,637,997	11.94	733	229,129	13.98	31,577
Feb.	32,879	9,293,711	12.62	625	199,956	14.27	32,254
Mar.*	33,447	9,845,776	13.14	1,172	390,551	14.88	32,275
Apr.*	44,218	13,967,712	14.10	984	343,785	15.59	43,234
May*	35,578	11,460,157	14.38	1,589	580,021	16.30	33,989
June	36,376	12,073,632	14.82	2,469	904,669	16.35	33,907
July	38,178	12,763,200	14.92	1,383	510,075	16.47	36,795
Aug.	40,027	13,364,916	14.91	840	307,114	16.32	39,187
Sept.*	48,368	16,691,919	15.41	656	244,554	16.64	47,712
Oct.	39,573	13,627,465	15.37	778	268,645	15.42	38,795
Nov.*	36,798	12,790,306	15.52	675	241,982	15.99	36,123
Dec.	49,312	17,555,705	15.89	677	267,745	17.65	48,635
1937:							
Jan.	42,002	15,408,242	16.38	844	372,053	19.69	41,158

* Revised.

Note: Annual figures for 1922-1936 revised on basis of information received on February 8, 1937. Figures for 1922 and 1923 include latex; guayule is included only in 1922.

United States Imports of Guayule, Balata, Jelutong, Liquid Latex

(All Quantities in Long Tons)

	Guayule: Tons	Guayule: Dollars	Balata: Tons	Balata: Dollars	Jelutong: Tons	Jelutong: Dollars	Liquid Latex (1): Tons	Liquid Latex (1): Dollars
1924	1,356	536,392	464	568,456	6,165	1,237,100	2,157	864,059
1925	3,781	1,803,448	517	574,750	6,749	1,642,531	3,272	3,537,510
1926	4,305	2,562,096	354	327,213	7,263	3,127,757	3,394	4,686,743
1927	5,018	2,674,957	582	477,246	7,785	2,448,657	1,495	1,170,650
1928	3,077	1,755,685	731	430,855	7,552	2,540,059	4,007	2,121,786
1929	1,275	545,175	728	566,964	8,204	2,458,126	3,729	1,788,391
1930	1,096	347,388	502	422,684	5,907	1,403,244	4,458	1,508,786
1931	....	.....	1,207	411,380	5,777	1,019,010	4,675	888,909
1932	....	.....	707	147,403	4,607	616,596	5,112	601,999
1933	....	.....	1,659	2,261,869	5,990	944,895	11,085	1,833,671
1934	398	75,349	1,054	438,209	4,987	943,752	13,107	3,643,221
1935	459	86,835	615	188,384	5,644	1,063,126	13,553	3,782,222
1936	1,229	286,552	535	199,368	6,163	1,296,364	19,852	6,659,899
1936:								
April	103	19,469	38	15,232	751	146,548	1,612	522,049
May	88	16,698	59	21,217	521	114,099	1,472	490,769
June	97	18,380	33	13,671	767	186,274	1,897	657,311
July	96	18,168	44	15,314	556	106,676	1,665	579,895
Aug.	146	37,147	72	23,715	321	64,769	1,761	602,992
Sept.	106	29,335	21	9,846	418	85,624	1,800	692,810
Oct.	114	31,489	11	4,815	452	102,485	1,392	500,817
Nov.	159	43,980	43	19,408	405	91,538	1,631	578,729
Dec.	134	36,972	14	7,247	538	109,208	2,070	735,156
1937:								
Jan.	160	44,166	10	4,348	247	56,056	1,337	535,546

(1) Weight given in pounds of dry rubber contained in latex.

Note: Annual figures for 1924-1936 revised on basis of information received on February 8, 1937.

U. S. Consumption of Crude Rubber

(Rubber Manufacturers' Association statistics raised to 100 per cent—All figures in long tons)
(All Quantities in Long Tons)

	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	36,194	28,557	29,648	22,645*	39,190*	46,636*	48,506	48,744
Feb.	33,302	28,797	31,821	21,392*	40,515*	42,720*	36,746	.....
Mar.	35,540	32,788	29,505	17,483*	47,003*	42,153*	42,703	.....
Apr.	39,686	33,321	27,518	25,928	44,853*	44,247*	51,897	.....
May	39,386	37,817	30,957	44,074	42,918*	41,101*	50,482	.....
June	34,195	37,916	41,475	50,743*	40,147*	36,156*	52,636	.....
July	29,508	31,397	29,976	49,614*	32,553*	35,917*	48,127	.....
Aug.	30,850	27,586	23,721	44,428*	33,216*	38,775*	46,657	.....
Sept.	25,515	23,638	23,847	35,281*	30,258*	37,086*	46,330	.....
Oct.	27,516	22,277	22,286	31,543*	31,253*	41,969*	49,509	.....
Nov.	23,691	22,943	23,231	28,831*	34,748*	42,310*	50,303	.....
Dec.	21,687	21,409	18,015	28,757*	36,569*	42,474*	49,626	.....
Tot.	375,980	348,986	332,000	400,719*	453,223*	491,544*	573,522	.....

* Revised.

Reclaimed Rubber in the United States

(All Quantities in Long Tons)

Year	Production	Consumption: Tons	Consumption: % to Crude	Stocks*	Year	Production	Consumption: Tons	Consumption: % to Crude	Stocks*
1927	189,144	178,471	47.6	24,980	1932	75,608	77,504	23.4	16,354
1928	208,516	223,000	50.4	24,785	1933	99,560	81,602	19.9	20,746
1929	218,954	226,588	48.4	27,464	1934	110,010	100,597	22.2	23,079
1930	157,967	153,497	40.8	22,006	1935	122,948	113,078*	23.0a	25,069
1931	133,351	124,126	33.9	19,257	1936	150,571	130,048	22.7	30,573

Figures on Monthly Basis

1936:									
Jan.	11,665	10,039	20.7	26,145	July	12,330	11,816	24.6	22,602
Feb.	10,188	7,366	20.1	28,267	Aug.	12,856	10,993	23.6	23,750
Mar.	10,712	8,767	20.5	29,161	Sept.	12,959	11,170	24.1	24,950
April	11,382	10,333	19.9	22,274	Oct.	14,737	12,606	25.7	26,389
May	11,512	10,398	20.6	22,852	Nov.	14,357	12,029	23.8	28,135
June	11,935	11,547	21.9	22,738	Dec.	15,938	12,984	26.2	30,573
1937:									
Jan.	15,129	13,366	27.5	31,610	July	.....	.....	...	.....
Feb.	.....	.....	...	.....	Aug.	.....	.....	...	.....
Mar.	.....	.....	...	.....	Sept.	.....	.....	...	.....
April	.....	.....	...	.....	Oct.	.....	.....	...	.....
May	.....	.....	...	.....	Nov.	.....	.....	...	.....
June	.....	.....	...	.....	Dec.	.....	.....	...	.....

* Stocks on hand at the end of month or year.
a Revised.

U. S. Consumption of Gasoline

(Bureau of Mines Statistics)
(In Thousands of Barrels of 42 Gallons)

	1935	1936	1937		1935	1936	1937
January	26,147*	32,553	.....	August	43,097*	46,081	.....
February	26,580*	27,216*	.....	September	37,976*	44,346	.....
March	32,272*	35,871	.....	October	41,566*	44,253	.....
April	36,363*	38,825	.....	November	35,991*	39,919	.....
May	39,381*	42,007	.....	December	33,872*	39,393	.....
June	38,086*	44,630	.....				
July	41,479*	46,638*	.....	Total	434,810*	.....	.....

* Revised.

Rims Inspected and Passed in U. S.

(Tire and Rim Association Reports)

	Total		Total		Total
1925	26,001,664	1929	24,141,502	1933	8,713,962
1926	24,199,524	1930	17,364,096	1934	12,255,118
1927	19,700,003	1931	11,253,800	1935	18,664,356
1928	24,247,282	1932	6,261,336	1936	20,790,098

1937:		1937:		1937:	
January ...	2,123,723	May	.....	September ..	.....
February ..	2,022,258	June	.....	October ...	.....
March	.....	July	.....	November ..	.....
April	.....	August	.....	December ..	.....

Daily Spot Closing Prices of Ribbed Smoked Sheet Rubber—*New York Market, in Cents per Pound*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Ave.
1934																																
November	13⅛	13⅛	13	—	13	—	13⅜	13¾	13¾	13¾	—	—	13¾	12⅞	13⅛	12⅝	12⅝	—	12¾	12¾	12½	12¾	12⅝	—	—	13⅛	13⅛	13⅛	—	—	—	13
December	13⅛	—	12⅞	13	13	13⅛	13⅝	13⅞	—	12⅛	12⅞	12⅛	12⅛	12⅛	12⅛	13	13	13	13	13	13	12⅛	12⅛	12⅛	12⅛	12⅞	12⅞	13	13	13⅛	—	—13
1935																																
January	—	13⅛	13½	13½	13½	—	13⅜	13¾	13⅜	13⅜	—	—	13¼	—	12⅝	13⅛	13⅛	13	13	13⅜	13⅛	—	—	—	—	—	—	—	—	—	—	
February	—	12⅜	12⅜	12⅜	12⅜	12⅝	12⅝	13⅛	13⅝	—	11¾	11¾	11⅝	12⅛	13	12⅞	11⅝	13⅛	10⅝	11⅛	10⅝	12⅛	13⅛	10⅝	12⅝	12⅜	12⅜	12⅜	12⅜	12⅜	12⅜	13⅜
March	—	12⅜	12⅜	12⅜	12⅜	12	12⅛	12⅝	12	—	11¾	11½	11⅛	11⅝	11	11⅝	11⅝	12⅛	10⅝	11⅛	10⅝	11⅛	11⅛	10⅝	11⅜	11⅜	11⅜	11⅜	11⅜	11⅜	—	12⅜
April	—	11⅜	11⅜	11⅜	11	11	11⅛	11⅜	10⅞	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	12⅛	12⅛	12⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	—	11½
May	—	11⅜	11½	11½	—	12⅛	12⅛	11⅜	11⅛	11⅛	11⅛	11⅛	11⅛	12⅛	12⅛	12⅛	12⅛	12⅛	11⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12
June	—	12⅛	12⅛	—	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12 7/16
July	—	12⅛	12¾	—	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12
August	—	12⅛	12¾	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12⅛	12
September	—	11¾	11¾	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛	11⅛
October	—	11¾	11¾	12	12	12	11⅞	12⅛	12	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞	11⅞
November	—	13⅜	12⅜	13⅛	13	13⅛	13⅜	13⅛	13¼	12⅞	13⅛	13	13	13⅜	13⅜	13⅜	13⅜	13⅜	13	13	13	13⅛	13⅛	13⅛	13⅛	13⅛	13⅜	13⅜	13⅜	13⅜	13⅜	13¾
December	—	13⅛	12⅜	12⅝	13	13⅛	13⅜	13⅜	13	13	13	13	13	13⅜	13⅜	13⅜	13⅜	13⅜	13⅛	13¼	13¼	13⅛	13⅛	13⅛	13⅛	13⅛	13⅜	13⅜	13⅜	13⅜	13⅜	13¾
1936																																
January	—	13½	13⅜	13⅜	—	13¾	13⅛	13⅛	13⅜	—	—	—	14⅜	14⅜	14⅜	14⅜	14⅜	14⅜	—	14⅜	14½	14⅜	14⅛	14⅛	15	15	15	14⅛	14⅛	14⅛	14⅛	14½
February	—	15⅛	15⅜	15⅜	15⅜	15⅛	15⅛	15⅛	15⅛	14	14⅜	14⅜	14⅜	14⅜	15½	15½	15½	15½	15⅛	15⅛	15¾	15⅛	14⅜	15⅛	15½	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15½
March	—	15⅜	15⅜	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅜	16	15⅛	15⅛	16	15⅛	15⅛	15⅛	15⅛	15⅛	16	16	15⅛	15⅛	16	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅜/16
April	—	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅝
May	—	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅝
June	—	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅝
July	—	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16½
Aug.	—	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16½
Sept.	—	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅝
Oct.	—	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅝
Nov.	—	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅝
Dec.	—	18½	18½	18½	19	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	19⅛	17⅞
1937																																
Jan.	—	—	—	20⅜	20⅜	21⅛	21⅛	21⅛	22⅛	21½	22⅜	22⅛	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21⅜
Feb.	—	21	21⅜	21⅛	21⅛	21½	21½	—	21¾	21⅛	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21⅜
Mar.	—	21⅛	21⅛	21⅛	22⅛	22⅛	—	—	22⅝	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Average Spot Closing Prices—Ribbed Smoked Sheets

(New York Market)

Average Price per Pound for Years 1910-1929

Year	Cents	Year	Cents	Year	Cents	Year	Cents	Year	Cents
1910	206.60	1914	65.33	1918	60.15	1922	17.50	1926	48.50
1911	141.30	1915	65.85	1919	48.70	1923	29.45	1927	37.72
1912	121.60	1916	72.50	1920	36.30	1924	26.20	1928	22.48
1913	82.04	1917	72.23	1921	16.36	1925	72.46	1929	20.55

Average Monthly Price per Pound Since 1930

	1930 Cents	1931 Cents	1932 Cents	1933 Cents	1934 Cents	1935 Cents	1936 Cents	1937 Cents
Jan.	15.24	8.34	4.38	3.08	9.32	13.10	14.35	21.37
Feb.	15.85	7.70	4.03	2.95	10.45	12.92	15.48	21.33
Mar.	15.34	7.71	3.35	3.01	11.01	11.51	15.89	
Apr.	14.93	6.43	3.02	3.56	12.10	11.55	15.98	
May	14.24	6.49	3.09	4.95	13.26	12.05	15.62	
June	12.45	6.35	2.66	6.15	13.51	12.57	15.85	
July	11.24	6.37	2.89	8.01	14.60	12.10	16.49	
Aug.	9.96	5.38	3.63	7.31	15.47	11.98	16.25	
Sept.	8.28	5.08	3.84	7.30	15.36	11.55	16.46	
Oct.	8.20	4.87	3.65	7.64	13.96	12.62	16.55	
Nov.	9.01	4.65	3.44	8.66	13.04	13.15	17.97	
Dec.	9.05	4.64	3.24	8.87	12.98	13.28	20.01	
Average for Year	11.98	6.17	3.49	5.96	12.92	12.37	16.41	

London Closing Prices of Ribbed Smoked Sheets

(In Pence Per Pound)

Day	1936 Dec.	1937 Jan.	1937 Feb.	1937 Mar.	Day	1936 Dec.	1937 Jan.	1937 Feb.	1937 Mar.
1	8	—	10¾	10¾	17	9¼	—	10½	
2	8	—	10⅞	10¾	18	9	10½	10⅜	
3	8	—	10⅜	10¾	19	9	10¼	10⅜	
4	9	9¾	10⅜	10¾	20	—	—	10⅜	
5	9	10	10½	10⅜	21	9⅞	10⅜		
6	—	10⅛	10⅝	11	22	9⅞	10¼	10½	
7	9⅛	10⅜	—	—	23	10⅛	10⅜	10½	
8	9⅛	10⅞	10⅞	11¼	24	10⅜	—	10⅜	
9	9	10⅜	10⅞	11⅛	25	—	10¼	10⅛	
10	9	—	10½		26	—	10½	10¾	
11	9	10⅛	10⅝		27	—	10¼	10⅛	
12	8	10⅛	10⅝		28	11⅛	10⅛		
13		10¾	10⅝		29	10⅛	10⅛		
14	9	10⅛	—		30	10⅛	10⅛		
15	9⅛	10¾	10½		31	10⅛	—		
16	9⅛	10⅜	10⅛						

Average Monthly Price Per Pound

Month	1934 Pence	1935 Pence	1936 Pence	1937 Pence	Month	1934 Pence	1935 Pence	1936 Pence	1937 Pence
Jan.	4.429	6.434	6.758	10.378	Aug.	7.401	5.696	7.581	
Feb.	4.920	6.292	7.255	10.503	Sept.	7.409	5.508	7.577	
Mar.	5.136	5.745	7.450		Oct.	6.806	6.130	7.898	
Apr.	5.712	5.604	7.502		Nov.	6.294	6.308	8.572	
May	6.207	5.822	7.335		Dec.	6.295	6.340	9.580	
June	6.245	6.027	7.352		Average for				
July	7.053	5.801	7.696		Year	6.159	5.976	7.713	

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market)

Recent Daily Price Per Pound

Date	1937 Jan.	1937 Feb.	1937 Mar.	Date	1937 Jan.	1937 Feb.	1937 Mar.	Date	1937 Jan.	1937 Feb.	1937 Mar.
1	—	13.29	13.50	11	13.03	13.17		22	12.97	—	—
2	—	13.25	13.60	12	13.09	—		23	12.97	13.08	
3	—	13.30	13.87	13	13.06	13.11		24	—	13.18	
4	12.91	13.25	13.84	14	13.01	—		25	12.98	13.20	
5	12.91	13.20	14.01	15	13.04	13.15		26	13.07	13.27	
6	12.96	13.21	14.18	16	13.07	13.06		27	13.22	13.34	
7	13.07	—	—	17	—	12.98		28	13.30	—	—
8	13.01	13.16	14.05	18	13.08	12.97		29	13.28	—	—
9	13.06	13.16	14.27	19	13.04	12.96		30	13.33	—	—
10	—	13.11		20	12.98	12.95		31	—	—	—
				21	12.95	—					

Average Monthly Price Per Pound

	1934 Cents	1935 Cents	1936 Cents	1937 Cents		1934 Cents	1935 Cents	1936 Cents	1937 Cents
Jan.	11.25	12.70	11.91	13.06	Aug.	13.40	11.48	12.28	
Feb.	12.28	12.58	11.53	13.15	Sept.	13.00	10.80	12.31	
Mar.	12.30	11.63	11.43		Oct.	12.48	11.28	12.30	
Apr.	11.80	11.73	11.71		Nov.	12.53	12.01	12.23	
May	11.44	12.25	11.68		Dec.	12.76	11.99	12.83	
June	12.20	11.89	12.02		Average for				
July	12.84	12.26	13.11		Year	12.36	11.88	12.11	

World Stocks of Crude Rubber

(All figures are in long tons)

ON HAND OR AFLOAT TO THE U. S.

At End of	ON HAND 1935	ON HAND 1936	ON HAND 1937	AFLOAT 1935	AFLOAT 1936	AFLOAT 1937	ON HAND AND AFLOAT 1935	ON HAND AND AFLOAT 1936	ON HAND AND AFLOAT 1937
Jan.	349,446	285,054*	201,915	42,066	43,870	55,096	391,512	328,924*	257,011
Feb.	340,264	282,902*		42,969	46,532		383,233	329,434*	
Mar.	340,284	276,823*		44,485	58,935		384,769	335,758*	
Apr.	337,586	264,228*		37,651	47,678		375,237	311,906*	
May	322,558	248,317		44,375	48,860		366,933	297,177	
June	324,218	245,886		55,581	47,228		379,799	293,114	
July	334,692	234,498		49,018	60,343		383,710	294,841	
Aug.	334,106	229,056		47,724	63,597		381,830	292,653	
Sept.	331,121	228,477		43,413	62,240		374,534	290,717	
Oct.	322,857	219,553		49,913	67,825		371,770	287,378	
Nov.	308,993	212,515		46,588	73,691		355,581	286,206	
Dec.	303,000	218,844		39,094	56,567		342,094	275,411	

(Rubber Manufacturers' Association figures raised to 100%)

* Revised.

Note: Complete figures for 1934 and 1935 were revised by the R.M.A. on May 1, 1936.

STOCKS IN GREAT BRITAIN

(No. of Tons in Wharves and Warehouses, not including Latex)

At end of	London 1935	London 1936	London 1937	Liverpool 1935	Liverpool 1936	Liverpool 1937
January	81,807	84,791	29,005	66,405	77,188	41,895
February	87,605	79,757		67,983	77,138	
March	92,664	74,779		69,218	72,823	
April	94,361	68,932		70,584	71,388	
May	95,722	61,349		71,927	69,150	
June	98,077	55,993		73,131	66,173	
July	99,226	49,575		74,915	63,715	
August	101,574	45,749		75,584	62,367	
September	101,198	44,364		76,263	59,485	
October	94,749	40,777		76,400	55,738	
November	90,542	37,495		76,301	51,184	
December	86,551	33,027		77,589	45,291	

(Figures from the Rubber Trade Association of London)

STOCKS IN OTHER CENTRES

(Figures from Statistical Bulletin of the Int'l Rubber Regulation Committee)

At end of 1936	Penang and Singapore [1]	Malaya [2]	Ceylon [2]	Holland	Para and Manaos
January	31,195	35,231*	4,504*	1,568	4,496
February	38,421	34,109	4,475	1,532	6,199
March	29,322	31,723	3,866	1,547	4,864
April	32,200	34,090	3,123	1,497	4,873
May	26,687	33,179	3,379*	1,360	4,522
June	28,260	34,166	3,057	1,070	4,502
July	29,443	34,395	3,610	1,026	4,696
August	28,289	34,849	3,961	979	1,742*
September	26,936	33,351	3,930	911	1,817
October	24,593	34,941	3,490	773	1,820
November	26,761	33,469	3,415		1,948
December	26,969		5,161		2,454

[1] Dealers' and Port Stocks. [2] Inside Regulated Areas. [3] Dealers' Stocks Only.
* Revised.

RUBBER STOCKS AFLOAT

End of: 1936:	Afloat for United States	Afloat for Europe	All Other * Afloat	Total * Afloat
January	43,870	20,160	19,970	84,000
February	46,532	18,690	19,778	85,000
March	58,935	16,820	14,245	90,000
April	47,678	17,025	18,297	83,000
May	48,860	18,670	21,470	89,000
June	47,228	20,200	22,572	90,000
July	60,343	20,300	25,357	106,000
August	63,597	19,800	15,603	99,000
September	62,240	18,090	15,670	96,000
October	67,825	20,790	17,385	106,000
November	73,691	20,000	12,309	106,000
December	56,567	20,000p	26,433	103,000
End of: 1937				
January	55,096	20,000p	20,904	96,000

* *Total Afloat* is an arbitrary estimate based on 1½ months' shipments as adopted by the Department of Commerce. *All Other Afloat* is determined by subtracting the amount of stocks in transit to the United States and Europe from the estimated total.
P—Preliminary estimate

TOTAL WORLD STOCKS

(Figures from the Survey of Current Business)

At end of	1931	1932	1933	1934	1935	1936
January	510,296	623,416*	634,797	661,948	698,153	600,479*
February	516,123	611,819*	626,227	663,308	686,195	599,355*
March	532,080	614,894*	638,428	666,382	678,809	574,594*
April	531,832	615,893*	629,159	658,796	677,006	558,583
May	528,855	612,474*	626,537	689,239	677,569	533,411*
June	533,021	595,712	613,055	672,804	671,525	511,931*
July	548,794	589,037	618,258	676,200	679,061	510,873*
August	555,931	597,274	617,449	674,702	680,644	492,439*
September	561,838	599,986	623,683	694,361	661,509	485,488*
October	588,873	609,368	636,597	680,616	655,000	478,190*
November	605,684	614,342	642,968	684,408	617,300*	458,637*
December	628,826	629,898	654,890	705,975	613,987*	454,000
Monthly Average	553,513	609,502*	630,171	677,395	666,397*	521,498

* Revised.

U. S. Tire and Tube Statistics[1]

(All Figures Represent Thousands)

AUTOMOBILE CASINGS

Figures for Recent Years

	1929	1930	1931	1932	1933	1934	1935	1936
Production	68,726	50,965	48,740	40,085	45,303	47,233	49,362	58,116
Shipments	69,395	53,638	50,061	40,251	44,094	46,687	50,183	55,363
Inventory [2]	11,838	9,003	7,775	7,644	8,888	9,455	8,196	11,114

Figures for Recent Months

	PRODUCTION 1934	PRODUCTION 1935	PRODUCTION 1936*	SHIPMENTS 1934	SHIPMENTS 1935	SHIPMENTS 1936*	INVENTORY 1934	INVENTORY 1935	INVENTORY 1936*
Jan.	3,922	4,626	4,579	3,222	3,663	3,875	9,684	10,398	8,917
Feb.	4,335	4,383	3,579	3,285	3,287	3,212	10,725	11,530	9,265
Mar.	5,180	4,346	3,640	4,223	4,204	3,857	11,651	11,675	9,087
Apr.	4,470	4,512	4,857	4,438	5,144	4,904	11,981	11,003	9,035
May	4,456	4,175	4,974	5,332	4,067	5,833	11,127	11,131	8,178
June	4,342	3,910	5,612	5,228	4,262	5,793	10,219	10,755	7,835
July	3,353	3,532	5,466	4,157	5,447	5,744	9,437	8,850	7,750
Aug.	3,533	3,993	5,017	4,308	4,739	4,977	8,697	7,805	7,799
Sept.	2,936	3,787	4,984	3,183	3,303	3,837	8,419	8,288	9,012
Oct.	3,287	4,051	5,126	3,010	4,055	4,082	8,657	8,291	10,096
Nov.	3,341	3,997	4,972	3,191	3,930	4,233	8,779	8,249	10,823
Dec.	3,778	4,051	5,311	3,109	4,081	5,016	9,455	8,196	11,114

AUTOMOBILE INNER TUBES

Figures for Recent Years

	1929	1930	1931	1932	1933	1934	1935	1936
Production	68,829	52,420	48,333	36,891	42,556	46,228	47,879	57,607
Shipments	70,592	54,938	50,021	37,911	41,391	45,046	48,067	54,626
Inventory [2]	12,807	9,999	7,922	6,749	7,815	9,180	8,231	10,985

Figures for Recent Months

	PRODUCTION 1934	PRODUCTION 1935	PRODUCTION 1936	SHIPMENTS 1934	SHIPMENTS 1935	SHIPMENTS 1936	INVENTORY 1934	INVENTORY 1935	INVENTORY 1936
Jan.	3,551	4,259	4,592	3,199	3,722	4,168	8,403	9,621	8,623
Feb.	4,078	4,171	3,556	3,323	3,362	3,446	9,167	10,466	8,699
Mar.	5,194	4,123	3,787	4,118	4,168	3,796	10,244	10,406	8,692
Apr.	4,735	4,259	4,824	4,342	4,453	4,746	10,585	10,170	8,788
May	4,359	3,892	4,819	4,902	3,451	4,919	10,043	10,615	8,719
June	4,097	3,480	5,035	5,309	4,024	5,504	8,795	10,050	8,105
July	3,531	3,251	5,177	4,323	5,269	5,758	8,053	8,005	7,725
Aug.	3,680	3,894	5,039	4,198	4,556	5,136	7,555	6,939	7,621
Sept.	3,110	4,125	5,161	3,024	3,426	4,231	7,639	7,565	8,627
Oct.	3,219	4,435	5,397	2,689	3,987	4,108	8,151	8,053	9,977
Nov.	3,169	3,942	4,739	2,767	3,687	3,995	8,503	8,161	10,732
Dec.	3,503	4,048	5,121	2,850	3,962	4,819	9,180	8,231	10,985

(1) These figures have been adjusted to represent 100% of the industry based on reports received by the Rubber Manufacturers' Association which represent 80% for 1931-1932-1933; 97% for 1934-1935; 81% for 1936. All figures through September, 1936, were revised in December, 1936. Annual figures are more accurate.
(2) Held by manufacturers at end of period indicated.
(*) Revised.

Automobile Production

	United States Total	United States Passenger Cars	United States Trucks	Canada Total	Canada Passenger Cars	Canada Trucks	Grand Total
1928	4,357,384	3,826,613	530,771	242,382	196,737	45,645	4,599,944
1929	5,358,420	4,587,400	771,020	263,295	207,498	55,797	5,621,715
1930	3,355,986	2,814,452	540,534	154,192	125,442	28,750	3,510,178
1931	2,389,730	1,973,090	416,640	82,621	63,477	19,144	2,472,351
1932	1,370,678	1,135,493	235,187	60,816	50,718	10,098	1,431,494
1933*	1,920,057	1,573,512	346,545	65,924	53,855	12,069	1,992,124
1934*	2,753,111	2,177,919	575,192	116,852	92,647	24,205	2,869,963
1935*	3,946,934	3,252,244	694,690	172,877	135,562	37,315	4,119,811
1936	4,454,535	3,676,063	778,472	162,322	131,308	31,014	4,616,857
1936							
April	502,775	417,133	85,642	24,951	20,247	4,704	527,726
May	460,565	385,507	75,058	20,006	16,389	3,617	480,571
June*	452,955	375,894	77,061	16,400	13,126	3,274	469,355
July	440,999	372,402	68,597	10,475	8,192	2,283	451,474
August	271,291	209,754	61,537	4,660	3,051	1,609	275,951
Sept.	135,130	90,597	44,533	4,655	2,481	2,174	139,785
Oct.	224,628	190,688	33,940	5,361	4,592	769	229,989
Nov.	394,890	341,456	53,434	10,812	10,086	726	405,702
Dec.	498,721	426,019	72,702	20,411	16,542	3,869	519,132
1937							
Jan.	379,843	309,594	70,249	19,583	15,009	4,574	399,426
Feb.							
Mar.							

* Revised.
Note: U. S. figures represent factory sales; Canadian figures represent production.

Exports of Crude Rubber from Principal Producing Countries

(Long Tons)

	BRITISH MALAYA [1]			DUTCH EAST INDIES [2]										
	Gross Exports	Imports	Gross Exports Minus Imports	Ceylon [3]	India & Burma [3]	Sarawak [4]	British North Borneo [3]	Siam [4]	Java & Madura	Sumatra E. Coast	Other D.E.I.	Indo-China [3]	Amazon Valley	All Other [5]	World Total [1]
1923	252,016	70,432	181,584	39,971	6,416	5,705	4,237	1,718	32,930	46,344	57,822	5,067	16,765	7,856	406,415
1924	259,706	108,524	151,182	39,997	7,697	6,699	4,621	2,962	42,446	54,497	80,347	6,688	23,165	9,065	429,366
1925	316,825	158,022	158,803	49,566	10,082	5,424	5,377	5,377	46,757	65,499	120,626	7,881	25,298	13,797	514,487
1926	391,328	151,243	240,085	58,962	9,874	9,155	6,079	4,027	52,186	71,413	121,231	8,203	24,298	16,017	621,530
1927	371,322	182,845	188,477	55,356	11,321	10,923	6,582	5,472	55,297	77,815	142,171	8,645	28,782	15,633	606,474
1928	409,430	149,787	259,643	57,267	10,790	10,087	6,698	4,813	58,848	82,511	121,770	9,548	21,129	10,690	653,794
1929	574,830	163,092	411,744	81,584	11,663	11,077	7,381	5,018	65,990	87,789	134,037	9,696	21,148	6,767	853,894
1930	547,043	133,876	413,167	76,970	10,782	10,309	6,781	4,251	69,755	79,396	115,254	7,665	14,260	5,651	814,241
1931	519,740	125,506	394,234	61,769	8,470	10,451	6,247	4,218	75,952	87,747	116,009	11,696	12,121	3,292	792,203
1932	478,252	92,539	385,713	48,973	3,888	6,960	4,664	3,451	61,312	79,837	85,871	13,883	6,450	1,816	702,818
1933	573,412	167,377	406,035	63,351	4,527	10,874	7,555	7,765	73,851	91,861	149,659	18,394	9,883	2,737	846,312
1934	677,361	211,803	465,558	79,746	10,492	17,233	11,103	17,345	87,400	112,058	175,470	20,170	8,903	2,985	1,008,663
1935	590,319	174,652	415,667	54,316	13,968	19,465	8,885	28,327	57,488	78,325	139,297	28,816	11,275	8,745	864,574
1936	520,286	167,799	352,487	49,692	14,724	21,243	8,177	33,702	61,307	84,577	152,205	40,782	14,193	11,466	845,431
1935:															
Apr.	53,360	16,029	37,331	3,749	539	1,875	846	1,661	5,574	6,869	13,115	2,005	963	420	74,947
May	51,353	23,720	27,633	4,473	1,084	1,977	848	2,752	6,217	7,930	21,541	2,365	832	718	78,370
June	49,751	18,637	31,114	3,525	1,101	1,983	603	2,869	5,698	8,281	14,416	2,048	659	714	73,011
July	48,975	11,257	37,718	4,106	766	1,752	1,164	1,729	5,909	5,663	8,664	1,939	427	709	70,546
Aug.	51,873	10,978	40,895	5,683	565	772	566	2,328	4,660	6,923	9,087	2,433	1,150	725	75,787
Sept.	51,247	10,365	40,882	4,053	710	1,758	421	1,949	4,089	5,862	9,637	2,601	1,121	669	73,752
Oct.	48,258	19,364	28,894	5,932	1,284	1,684	1,040	2,679	3,937	6,711	16,818	2,260	1,292	714	73,245
Nov.	43,147	10,518	32,629	4,288	2,273	1,141	455	2,303	3,724	3,818	8,863	2,445	907	876	63,722
Dec.	37,838	7,529	30,309	4,942	3,028	1,233	171	3,079	3,881	5,206	3,854	4,532	1,352	1,122	62,709
1936:															
Jan.	39,101	12,582	26,519	4,178	1,299	2,317	938	1,665	4,315	6,347	9,381	2,449	1,606	839	61,853
Feb.	38,436	18,857	19,579	3,664	1,382	2,107	529	3,663	4,789	6,643	15,851	2,892	1,201	1,051	63,353
Mar.	46,552	12,026	34,526	4,336	1,324	1,848	342	2,966	4,484	5,052	9,225	2,553	1,264	751	68,671
Apr.	36,251	14,702	21,549	3,172	1,230	2,053	869	1,596	4,895	6,446	13,032	2,416	1,056	947	59,261
May	46,568	12,527	34,041	2,560	1,117	2,354	517	2,077	4,258	6,015	10,766	2,281	956	776	67,718
June	40,049	15,026	25,023	3,766	1,226	1,386	461	3,737	4,577	6,519	14,588	2,733	917	823	65,756
July	53,114	19,038	34,076	3,773	1,359	1,399	1,035	3,734	6,133	8,578	17,946	2,738	964	933	82,668
Aug.	43,506	13,361	30,145	3,940	776	2,541	656	3,284	4,978	7,353	12,106	3,017	542	1,054	70,392
Sept.	44,110	10,039	34,071	5,367	664	1,139	537	3,259	4,531	6,241	10,175	3,505	1,119	937	71,545
Oct.	46,543	12,960	33,583	5,599	1,181	2,143	1,086	3,349	6,477	8,145	12,881	3,874	1,255	1,105	80,678
Nov.	47,342	16,923	30,419	4,960	1,322	1,950	701	2,260	5,398	7,109	16,718	3,872	1,592	1,163	77,464
Dec.	38,714	9,758	28,956	4,377	1,844		506	2,988	6,472	10,129	9,536	8,450	1,721	1,087	76,072
1937:															
Jan.	41,571	16,956	24,615	4,541	919	4,063	1,077	3,849	5,136	8,011	12,888	2,909	1,500*	1,000*	70,508
Feb.	38,058	14,048	24,010	5,619											

(1) Malayan net exports cannot be taken as production, since imported rubber is largely wet native rubber, which is reduced about one-third in weight by remilling; rubber exported as latex is not included which on a basis of 3½ pounds per gallon amounted to 115 tons in 1923, 1,117 in 1924, 3,618 in 1925, 3,263 in 1926, 2,439 in 1927, 1,437 in 1928, 2,670 in 1929, and 1,274 in 1930. (2) Ceylon Chamber of Commerce statistics until 1926; rubber exported as latex is not included—such shipments were equivalent to 18 tons in 1923, 93 tons in 1924, 6 tons in 1925, 20 tons in 1926, about ½ ton in 1927, and 1 ton in 1928, and practically none in 1929, 1930 and 1931. (3) Official statistics. (4) Imports into Singapore and Penang. (5) Exports from "Other D.E.I." are chiefly wet native rubber, which is reduced about one-third in weight by remilling; rubber exported as latex is not included which on a basis of 3½ pounds per gallon amounted to 2,342 tons in 1923, 1,008 tons in 1924, 2,239 tons in 1925, 44 tons in 1926, 84 tons in 1927, 1,459 tons in 1928, 1,302 tons in 1929, and 2,656 tons in 1930. (6) Calculated from official import statistics of principal consuming countries, viz., United States, United Kingdom, France, Germany, Belgium and Netherlands, and includes guayule rubber. (7) This total includes the third column for British Malaya, "Gross Exports minus Imports," and all the figures shown for the other territories. * Figure is provisional; final figure will be shown when available

NOTE: ANNUAL FIGURES ARE MORE ACCURATE; THEY ARE REVISED AT THE END OF THE FOLLOWING YEAR.

Net Imports of Crude Rubber into Principal Manufacturing Countries

(*Long Tons*)

	United States [1]	United Kingdom	France (h)	Germany	Canada (ac)	Japan (da)	Italy	Russia (ce)	Australia (cd)	Belgium (d)	Netherlands	Scandinavia (abcdf)	Spain (g)	Czechoslovakia (abcd)	World Total
1919	238,407	42,671	17,685	5,584	6,395	9,753	9,894	75	1,002	3,995	2,771	3,149	2,418	9	343,808
1920	249,530	56,844	13,885	11,890	11,746	5,297	6,123	62	1,815	3,840	5,510	2,292	2,008	567	371,409
1921	179,736	42,087	15,135	21,920	8,124	21,713	3,906	165	1,014	1,705	1,022	1,279	2,245	569	300,620
1922	296,594	11,724	24,352	27,546	9,207	15,934	6,430	2,493	2,643	172	—3,807	1,778	589	567	396,222
1923	301,527	12,700	27,392	18,519	13,277	15,372	8,489	2,986	1,649	2,184	792	2,528	630	1,128	409,173
1924	319,103	—11,550	30,446	22,727	14,299	19,571	8,764	2,346	3,124	2,688	—807	3,178	944	1,370	416,203
1925	385,596	4,061	32,956	33,937	19,683	11,117	11,412	7,088	4,757	2,930	875	3,149	1,155	1,558	520,274
1926	399,981	84,865	34,240	22,773	20,229	18,125	9,809	6,529	9,021	2,498	2,670	4,046	1,299	1,870	617,957
1927	403,472	60,249	34,271	38,892	26,405	20,521	11,381	12,018	9,490	6,482	636	4,224	2,055	2,672	632,768
1928	407,572	4,846	36,498	37,855	30,447	25,621	12,433	15,134	8,430	7,958	2,243	4,418	3,178	3,138	599,771
1929	528,608	122,675	55,093	49,275	35,453	34,284	17,169	11,774	15,886	9,445	3,022	6,440	864	4,650	894,638
1930	458,036	120,069	68,503	45,488	28,793	33,039	18,639	16,387	5,354	10,635	2,924	7,710	2,400	4,468	822,445
1931	475,993	86,170	46,466	39,688	25,261	43,483	10,149	30,671	7,649	11,009	2,220	6,360	2,605	7,717	794,641
1932	393,844	44,086	42,506	45,121	20,917	56,027	14,469	30,637	12,576	9,519	2,851	7,262	4,359	9,444	693,618
1933	398,365	73,335	61,953	54,120	19,332	66,831	19,341	29,830	13,534	11,166	1,243	7,831	5,520	10,402	772,803
1934	439,172	158,482	49,560	59,330	28,439	69,905	21,398	47,271	9,642	9,115	3,758	12,418	6,900	10,999	926,389
1935	455,758	128,829	51,450	62,899	26,870	57,567	21,880	37,572	9,978	7,593	4,068	11,878	8,140	11,245	895,727
1936	475,359	—2,591	57,032	71,794	27,871	61,223	17,000*	30,541	14,109	9,648	2,888	11,236	6,668	8,772	791,550
1935:															
Sept.	35,256	11,223	3,740	5,453	1,604	3,590	1,696	1,593	449	806	282	1,030	793	914	68,429
Oct.	35,770	3,184	5,175	6,074	812	4,727	2,500*	4,876	829	539	671	1,000	597	742	67,496
Nov.	25,756	2,942	4,731	6,258	4,389	4,361	2,000*	4,859	783	449	245	1,206	1,044	1,276	60,298
Dec.	38,072	4,779	5,522	4,823	2,567	6,112	2,500*	4,906	1,019	1,074	287	1,359	750	1,466	75,236
1936:															
Jan.	33,260	4,573	6,755	5,545	1,759	4,355	1,500*	467	1,260	760	369	736	664	767	62,770
Feb.	33,789	1,271	6,264	5,257	1,900	2,786	1,000*	94	735	799	106	497	1,312	344	56,154
Mar.	33,743	—1,227	4,333	4,569	1,811	5,170	1,000*	4,376	819	1,033	339	754	1,113	410	58,243
April	44,948	2,097	4,250	5,497	1,079	4,929	1,500*	3,251	919	1,097	238	848	679	603	71,935
May	35,549	302	4,335	4,639	2,221	5,531	1,000*	4,220	1,034	698	103	657	500*	667	61,456
June	35,901	—1,493	4,846	5,698	2,042	4,567	1,500*	2,427	1,635	579	—27	650	500*	323	59,148
July	38,556	—766	4,621	6,837	2,274	5,126	2,000*	1,733	1,363	713	183	1,094	500*	495	64,729
Aug.	41,094	—1,581	4,513	6,556	3,781	4,305	1,500*	3,128	807	789	42	1,145	500*	989	67,440
Sept.	49,483	—12	4,393	6,006	2,393	5,195	1,500*	2,922	2,297	514	471	1,090	300*	624	77,176
Oct.	40,301	—87	4,752	7,232	3,110	6,600	1,500*	2,761	1,092	817	343	1,171	200*	1,026	70,818
Nov.	37,897	—742	3,282	6,500	4,308	3,961	1,500*	2,162	964	1,090	445	1,388	200*	823	63,778
Dec.	50,838	—4,926	4,688	7,458	1,193	8,698	1,500*	3,000*	1,184	759	276	1,206	200*	1,701	77,775
1937:															
Jan.	48,744	33	4,690	7,041											

a—Including gutta percha. b—Including balata. c—Re-exports not deducted in monthly statistics. d—Including some scrap and reclaimed rubber. e—Official statistics of rubber imports by Soviet Russia. f—Including Norway, Sweden, Denmark and Finland. g—United Kingdom and French exports to Spain except in years prior to 1925. h—French imports have been reduced 12 per cent in order to eliminate imports of gutta percha and to reduce to basis of net weight. [1] United States imports of guayule are included in this compilation. * Figure is provisional; final figure will be shown when available.

NOTE: ANNUAL FIGURES ARE MORE ACCURATE; THEY ARE REVISED AT THE END OF THE FOLLOWING YEAR.

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